The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

October 1945

Urology . Gynecology

Orthopedic Surgery . Proctology

Biliary Surgery . Intestinal Surgery

Fifty-fourth Year of Continuous Publication

The American Journal of Surgery, Inc.

49 WEST FORTY-FIFTH STREET · NEW YORK 19

EDITORIAL BOARD

The American Journal of Surgery

Editor THURSTON SCOTT WELTON, *New York*

ASSOCIATE EDITORS

CARL BECK, *Chicago*
CLAUDE S. BECK, *Cleveland*
GEORGE R. BRIGHTON, *New York*
MEREDITH F. CAMPBELL, *New York*
JAMES T. CASE, *Chicago*
ISIDORE COHN, *New Orleans*
BRADLEY L. COLEY, *New York*
FREDERICK A. COLLER, *Ann Arbor*
PAUL C. COLONNA, *Philadelphia*
ELLIOTT C. CUTLER, *Boston*
CHARLES A. ELSBERG, *New York*
HERBERT C. FETT, *Brooklyn*
JOHN H. GIBBON, *Philadelphia*
EMIL GOETSCH, *Brooklyn*
CHARLES A. GORDON, *Brooklyn*
DONALD GUTHRIE, *Sayre, Pa.*
ARTHUR E. HERTZLER, *Kansas City*
LOUIS J. HIRSCHMAN, *Detroit*
JAMES M. HITZROT, *New York*
EMILE F. HOLMAN, *San Francisco*
ARNOLD S. JACKSON, *Madison, Wis.*
WILLIAM L. KELLER, *Washington*
THOMAS J. KIRWIN, *New York*
New York, ARTHUR KRIDA
New York, ADRAIN V. S. LAMBERT
New York, MAURICE LENZ
New York, H. H. M. LYLE
New York, JEROME M. LYNCH
New Orleans, URBAN MAES
Newark, HARRISON S. MARTLAND
New Orleans, RUDOLPH MATAS
Detroit, ROY D. MCCLURE
San Francisco, H. C. NAFFZIGER
Baltimore, EMIL NOVAK
Newark, CLARENCE R. O'CROWLEY
Boston, LOUIS E. PHANEUF
New York, EUGENE H. POOL
Rochester, Minn., JAMES T. PRIESTLEY
New York, DOUGLAS QUICK
Brooklyn, NATHANIEL P. RATHBUN
Raleigh, HUBERT A. ROYSTER
Philadelphia, HENRY S. RUTH
St. Louis, M. G. SEELIG
New York, J. BENTLEY SQUIER
New York, H. J. STANDER
Baltimore, GRANT E. WARD
San Francisco, J. HOMER WOOLSEY

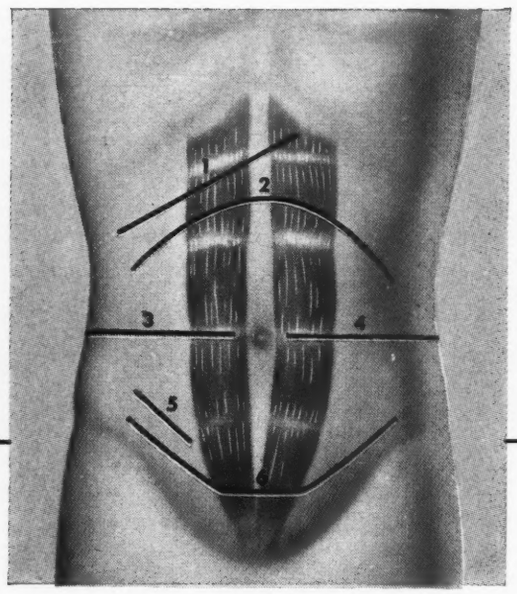
The American Journal of Surgery is published monthly by the American Journal of Surgery, Inc., 49 West 45th Street, New York 19, N. Y. Yearly Subscription, $10.00 U. S. A.; $15.00 Canada; $12.00 Foreign. Single Numbers $2.00; Special Numbers $4.00. Entered as second class matter August 28, 1926, at the Post Office, New York, N. Y., and on August 28, 1926, at York, Pa., under the act of March 3, 1879. October, 1945—New Series, Volume LXX, No. 1.

FACULTY OF MEDICINE, UNIVERSITY OF PARIS — The history of this famous medical school covers nearly seven hundred years of medical instruction. Probably the span is greater, since it is known that teaching was begun many years before the Faculty of Medicine was officially designated as a part of the University of Paris in 1281. Among the teachers, graduates and research scientists connected with this ancient school appear some of the most illustrious names in the annals of medicine. Today the Faculty of Medicine, with its modern laboratories, occupies these buildings adjacent to the Sorbonne.

Research is the right hand of medicine and surgery. It clears the trails that lead closer and closer to the goals of better health and well being toward which all medical men are striving. One phase of research concerns the development and improvement of sutures. In this field D&G has reached an advanced position, and as a result is constantly helping to increase the range and efficiency of the surgeon's technic by supplying him with better sutures with which to accomplish his purposes.

Incisions that Minimize

AN IMPORTANT ADVANCE IN THE TECHNIC OF SUTURING

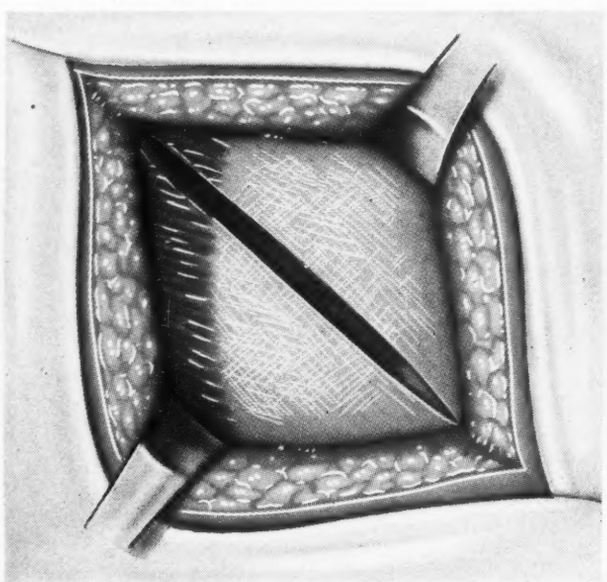


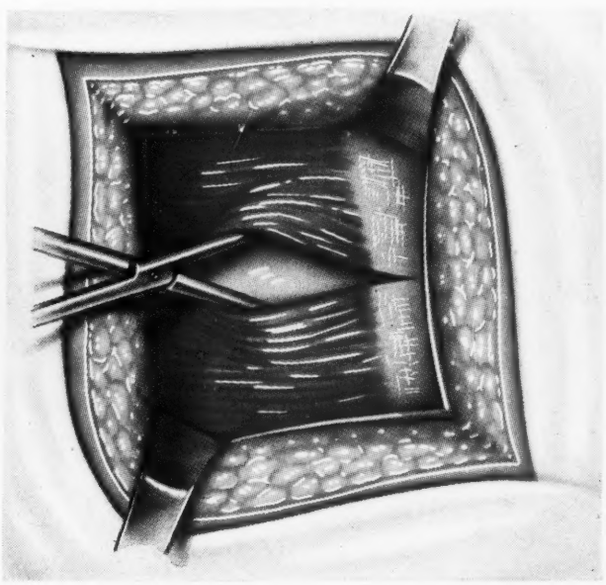
1. For gall bladder, common duct, head of pancreas.
2. Resection of stomach, transverse colon.
3. Resection of ascending colon, cecum, right sided lesions.
4. Descending colon, spleen and left sided lesions.
*5. Appendectomy.
6. Pelvic surgery, resection of sigmoid.

INCISIONS which offer maximal assurance against sutures pulling through the tissues eliminate a principal cause of wound disruption.

Sutures hold most securely if the connective tissues within the wound are approximated in such a manner that the sutures must pull against the fibres within these layers. This is possible only when connective tissues are cut parallel to the direction of their fibres. In the anterior abdominal wall, this is usually best accomplished through a transverse initial skin incision.

In suturing transverse incisions, no attempt is made to suture muscle—only the surrounding sheath. Approximation of the muscle edges is further aided by keeping the patient in a semi-reclining position with knees partially flexed.





Wound Disruption

NUMBER FIVE OF A SERIES

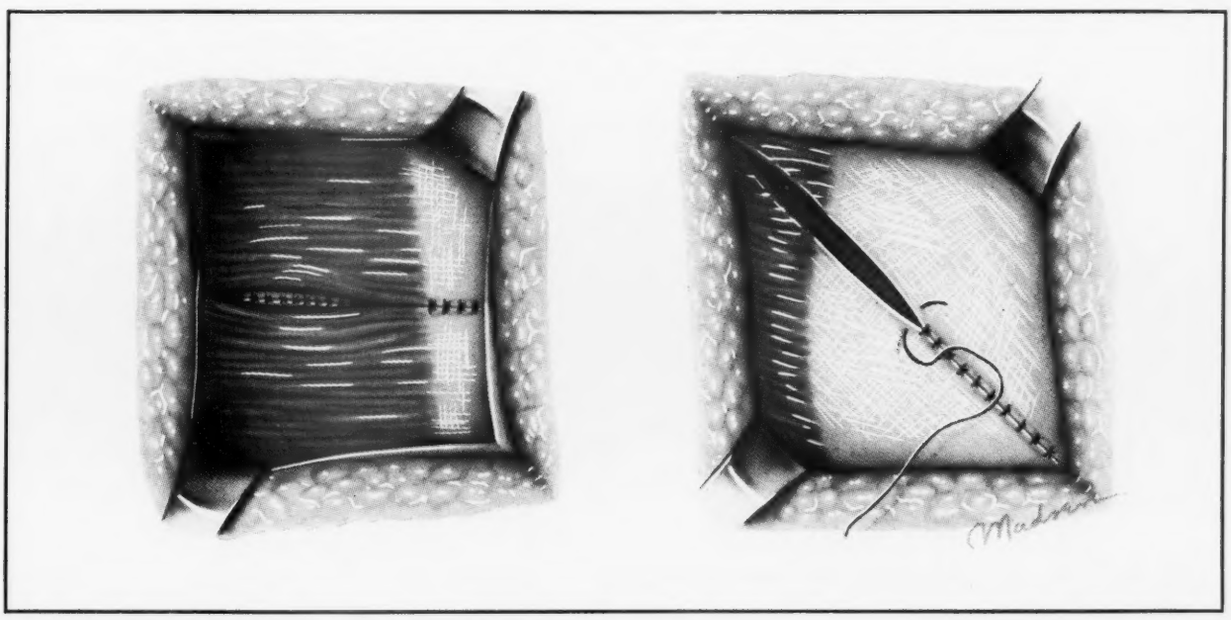
*THE McBURNEY OR GRIDIRON INCISION FOR APPENDECTOMY

The McBurney or gridiron incision employed to remove the diseased appendix is the most widely accepted yet perhaps the most frequently challenged of all incisions. Some surgeons feel that through this small incision, essential pathology may be overlooked and that the inadequate exposure it affords makes intraperitoneal surgery unnecessarily difficult. Others point out that this criticism is not justified since the incision can easily be enlarged to permit further exploration if the condition of the appendix does not explain the presenting symptoms. In addition, they cite the following advantages of the gridiron incision:

1. The retrocecal and lateral cecal appendix is more readily removed through it than through a longitudinal incision.
2. The appendiceal abscess can be drained through it without contaminating the general peritoneal cavity—a very real hazard in the treatment of the appendiceal abscess.
3. Fewer post-operative herniae are claimed for the McBurney incision than for others, and early ambulation was first practiced with this incision.

Wier obtained increased exposure with the McBurney incision by cutting the posterior and anterior sheath of the rectus muscle and retracting the muscle laterally. Since, however, experience has now demonstrated that the recti muscles can be cut without danger of subsequent deformity, the initial incision can readily be converted into a transverse incision across the entire abdomen if desired. This would seem to eliminate all criticism of the McBurney incision.

In making the McBurney incision, the skin should be cut transversely because incisions made in this direction not only spread less than the conventional slanting incision, but permit enlargement if necessary. The external oblique muscle and fascia are split in the direction of their fibres and after these are retracted the internal oblique and the muscle and fascia of the transversalis and peritoneum are cut horizontally. To enlarge the incision, the interior epigastric vessels are ligated and the rectus muscles and their sheaths are cut transversely. As with all the other transverse incisions, only the fasciae are sutured and all sutures pull against the fibres of the tissues.



Sutures for Every Surgical Situation

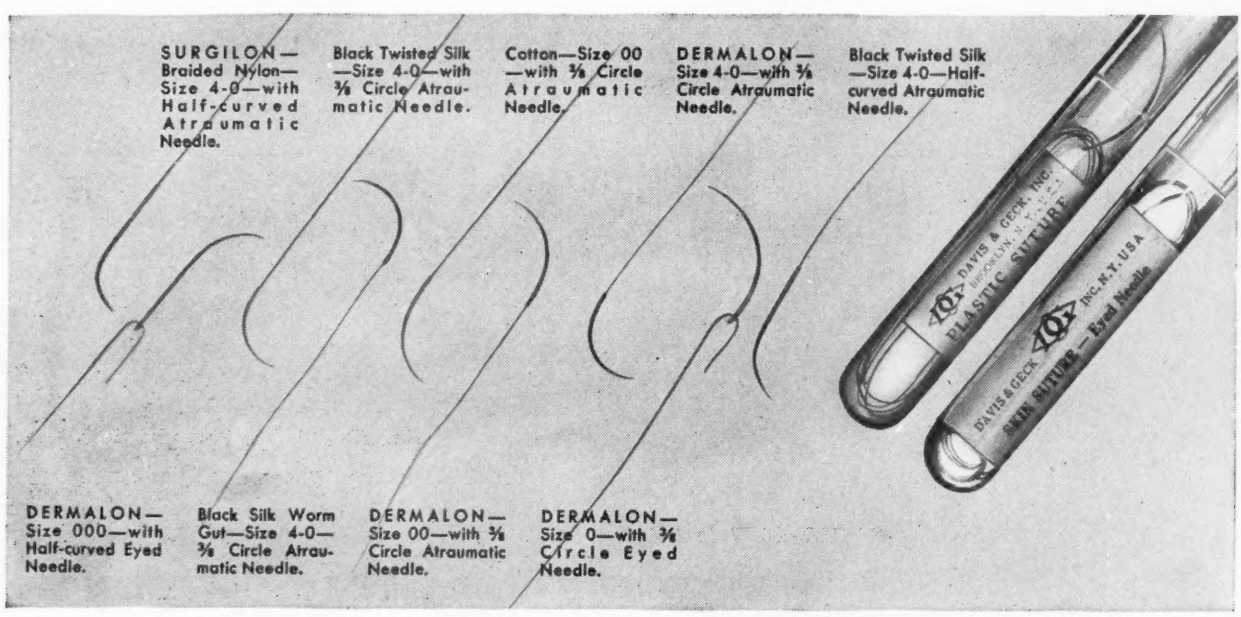
D&G DERMAL AND PLASTIC SUTURES

Working in close cooperation with surgeons on problems of skin closure and plastic surgery, D&G has developed an unexcelled line of Dermal and Plastic Sutures and Suture-Needle combinations. The aim has been to develop suture materials applicable to every technic, and to improve the characteristics of these sutures to the highest degree to provide the surgeon with a valuable adjunct to his technic.

An outstanding result is Dermalon, specially developed monofilament strands of nylon. Smoothness, elasticity, high tensile strength and impermeability are characteristics of the basic substance nylon. In order that the suture may be readily seen when imbedded in the dermal layers it is of a distinctive color which may be easily identified, thus facilitating the removal of the suture. Dermalon Sutures are supplied sterilized in tubes, and may be obtained equipped with swaged-on atraumatic needles for use in skin closure and tension suturing as well as in plastic surgery.

For those preferring the unsterilized Dermalon, it is available on reels so that whatever length is required may easily be removed.

Also available are Black Silkworm Gut, Black Twisted Silk, Surgilon (braided nylon), and Cotton in a range of sizes comparable with the varied requirements of Plastic and Dermal Surgery.


SURGILON—Braided Nylon—Size 4-0—with Half-curved Atraumatic Needle.
Black Twisted Silk—Size 4-0—with ⅜ Circle Atraumatic Needle.
Cotton—Size 00—with ⅜ Circle Atraumatic Needle.
DERMALON—Size 4-0—with ⅜ Circle Atraumatic Needle.
Black Twisted Silk—Size 4-0—Half-curved Atraumatic Needle.
DERMALON—Size 000—with Half-curved Eyed Needle.
Black Silk Worm Gut—Size 4-0—⅜ Circle Atraumatic Needle.
DERMALON—Size 00—with ⅜ Circle Atraumatic Needle.
DERMALON—Size 0—with ⅜ Circle Eyed Needle.
DAVIS & GECK, INC. BROOKLYN, N.Y. PLASTIC SUTURE
DAVIS & GECK INC. N.Y. U.S.A. SKIN SUTURE—Eyed Needle

DAVIS & GECK, INC.

57 WILLOUGHBY ST., BROOKLYN 1, N. Y.

THE GOLDEN OPPORTUNITY OF Iodine Remission

A stable, aqueous (1.21%) solution of resublimed iodine, largely in organic form. Contains no glycerin or alcohol. Available on prescription in 2 oz. bottles through all pharmacies.

When iodine medication must be withdrawn because of toxic reaction, the golden opportunity of iodine remission—the most auspicious time for thyroid surgery—is lost. Every surgeon knows how gravely this loss increases the patient's danger.

Amend's Solution, virtually nontoxic, is not attended by the threat of iodine intoxication. Therapeutically at least equal to the iodides or Lugol's solution, it is nevertheless so well tolerated that it is dependably safe—reactions are not encountered. In fact, in many instances Amend's Solution—instituted immediately after other iodines had to be withdrawn—permitted continuation of therapy and rapid disappearance of all signs of intoxication.

Amend's Solution owes this greater safety to its iodoprotein molecule which releases its iodine slowly and avoids the stormy fluctuation of tissue iodine levels which follows the iodides and to which intoxication is attributed.

Thos. Leeming & Co. Inc. • 155 East 44th St., New York 17, N. Y.

Amend's SOLUTION

The American Journal of Surgery

New Series Vol. lxx — Contents • October, 1945 — Number One

Editorial

Early Ambulation after Operation . . . . . *Roy D. McClure* 1

Original Articles

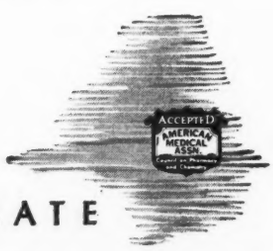
Established Surgical Infections. Treatment with Urea-Sulfanilamide Mixture . . . . . *Chester W. Brown, Leslie A. McClintock and Edward R. Neary* 4

Ligation of a Supernumerary Ureter. Clinical and Experimental Study. . . . . *Albert E. Goldstein and Ben Klotz* 13

Contents Continued on Page 3

BASAL anesthesia produced by the rectal instillation of a solution of Avertin with amylene hydrate generally lasts for two hours or more . . . With a relatively small dose of a supplemental anesthetic satisfactory muscular relaxation may be secured for a prolonged period . . . General anesthesia is usually maintained on a relatively high oxygen intake.

Avertin with amylene hydrate is supplied in bottles of 25 cc. and 100 cc., each 1 cc. containing 1 Gm. of Avertin and 0.5 Gm. of amylene hydrate.



AVERTIN

Trademark Reg. U. S. Pat. Off. & Canada

Brand of TRIBROMETHANOL

WITH AMYLENE HYDRATE

WINTHROP CHEMICAL COMPANY, INC.

Pharmaceuticals of merit for the physician

NEW YORK 13, N. Y. WINDSOR, ONT.

The American Journal of Surgery, Inc.

Reg. U. S. Pat. Off., Nov. 3, 1936

NEW SERIES VOL. LXX — *Contents • October, 1945* — NUMBER One

Intervertebral Spine Fusion with Removal of Herniated Intervertebral Disk . . . . . *J. M. Ovens and Lieut. Comdr. H. G. Williams* 24

Fracture of the Zygomatic Bone and Arch Postoperative Headgear . . *Major Adolph A. Schmier* 27

Acute Suppurative and Gangrenous Cholecystitis . . . *Nathan Blumberg and Louis Zisserman* 38

Metatarsal March (Fatigue) Fractures . . . . . *Albert L. Leveton* 49

Chlorophyll and Adrenal Cortical Extract in the Local Treatment of Burns . *G. H. Collings, Jr.* 58

Esophageal Diverticulum . . . . . *Frank Bortone* 64

Modifications of the Trocar Method with Positive Pressure for Instilling Amniotic Fluid Concentrate Intra-abdominally at the Close of Operations . . . . . *H. J. Merkle* 68

Modification of Radical Operation for the Cure of Ingrown Toenails *Lieut. Col. William L. Sibley* 79

What Was Wrong with Whitehead's Work? An Appraisal of His Rectal Operation . *Chelsea Eaton* 83

Case Reports

Brodie's Abscess. Two Case Reports . . *Lieut. James W. Downey and Major Harold E. Simon* 86

Congenital Eventration of the Diaphragm. Surgical Management . . . . . *J. Dewey Bisgard and George E. Robertson* 95

Criminal Abortion. Three Case Reports . . . . . *Theodore Cianfrani* 100

Torsion of the Testicle . . . . . *Captain William J. Foley* 105

Granulocytopenia Complicating Sulfadiazine Therapy in a Severe Intestinal Injury. Report of a Case in Which Penicillin Was Employed to Supplement Other Therapeutic Measures . . . . . *Colonel James E. Fish and Major Harold A. Conrad* 109

Submucous Lipomas of Colon with Special Reference to Acute and Chronic Intussusception. . . . . *Joseph A. Lazarus and Morris S. Marks* 114

Fistula of Submaxillary Gland Following Excision of Thyroglossal Cyst . *Lieut. Col. H. B. Jenkins* 118

Lymphosarcoma of the Small Intestine . . . . . *Harry Berman and Captain Frank Mainella* 121

Fetal Bones Passed in the Feces . . . . . *Ben Fruhlinger* 126

New Instruments

Improved Needle Holder. . . . . *Levon A. Akopiantz* 128

Anal Retractor for Use in Anorectal Surgery . . . . . *J. Rembrandt Helfrick* 131

Device to Protect the Projecting End of Kirschner Wires, Steinmann's Pin or External Fixation Pins . . . . . *Harold D. Caylor and Lee Witwer* 133

Stethoscope for Doctors with Hearing Defects. . . . . *Lieut. Col. Harry M. Kirschbaum* 134

Bookshelf Browsing

Historical Aspects of Cardiac Resuscitation . . *Robert F. Barber and Capt. John L. Madden* 135

General Information on Page 4 *Advertising Index on 3rd cover*

General Information

THE AMERICAN JOURNAL OF SURGERY does not hold itself responsible for any statements made or opinions expressed by any contributor in any article published in its columns.

Articles are accepted for publication with the understanding that they are original contributions never previously published. All manuscripts are subject to editorial modification, and upon acceptance become the property of THE AMERICAN JOURNAL OF SURGERY, INC.

A reasonable number of illustrations are supplied free of cost; special arrangements must be made with the editor and publishers for excess illustrations and elaborate tables.

Reprints are furnished on order. Prices are quoted when articles are in page form.

Material published in THE AMERICAN JOURNAL OF SURGERY is copyrighted and may not be reproduced without permission of the publishers.

Change of address must reach us by the 15th of the month preceding month of issue.

PREPARATION OF MANUSCRIPTS

Text. Manuscripts are to be typewritten, on one side of the paper, with double spacing and good margins. The original should be sent to the editor and a carbon copy retained by the author.

Illustrations. Illustrations must be in the form of glossy prints or drawings in black ink (*never* in blue). On the back of each illustration the figure number, author's name and an indication of the top of the picture should be given. Legends for illustrations are to be typewritten in a single list, with numbers corresponding to those on the photographs and drawings. Please do not attach legends to the pictures themselves.

Bibliographies. Bibliographic references should be at the end of the manuscript, in alphabetical order, and not in footnotes. Each reference should include the following information in the order indicated: Name of author with initials; title of article; name of periodical; volume, page and year. The following may be used as a model:

PHANEUF, LOUIS E. Indications and technique. *Am. J. Surg.*, 25: 446, 1937.

The author should always place his full address on his manuscript.

The subscription price of THE AMERICAN JOURNAL OF SURGERY, is $10.00 per year in advance in the United States; $15.00 in Canada; and $12.00 in foreign countries. Current single numbers $2.00. All Special Numbers $4.00. Prices for such back numbers as are available will be quoted on request.

Address all correspondence to

The American Journal of Surgery, Inc.

49 WEST 45TH STREET · NEW YORK 19

To ensure restful sleep, physicians have learned, through years of gratifying clinical experience, to rely on Allonal, the Roche hypnotic-analgesic. Its effect takes place smoothly and gently yet with sufficient forcefulness to insure the desired sedation and analgesia. Moreover, the use of Allonal is seldom accompanied by "hangover." A dose of 1 or 2 Allonal tablets—and the patient drops off into calm, refreshing sleep of normal duration which is followed by a bright, clear-headed awakening. Allonal assures the patient of a good night's rest. Allonal is available in boxes of 12 and 50 for your prescription.

HOFFMANN-LA ROCHE, INC., ROCHE PARK, NUTLEY 10, N. J.

Allonal 'ROCHE'

Specify AMERICAN

. . . surgical operating tables and affiliated equipment

The AMERICAN—1075 OPERATING TABLE

The optimum in accommodation of the different surgical specialties with simplicity of control. Permits positioning of patient in infinite number of surgical postures while safely immobilized under anesthetic . . . in such convenient relation to operating surgeon that he may work comfortably and without undue fatigue in both sitting and standing positions.

AMERICAN —SERIES 1060 OPERATING TABLES

Pedestal type tables of superior design and precision workmanship. Offering desired flexibility and simplicity of operation, their rugged construction reduces service requirements to a negligible minimum.

AMERICAN "Albee-Comper" ORTHOPEDIC and FRACTURE TABLE

Designed for open and closed fracture and orthopedic operations. Fully maneuverable with Floorlock and Trendelenberg • Mechanically operated Lateral Tilt • Hydraulic height-control • Adjustable Table-tops for easy application of plaster casts • Overhead Frame, mounted on mechanically controlled hoist for Davis hyper-extension, Sayre suspension • Unprecedented x-ray approach.

AMERICAN "Hawley" FRACTURE TABLE

AMERICAN "MacEachern" OBSTETRICAL TABLE

AMERICAN OBSTETRICAL BED, #1213

AUTOPAN BED

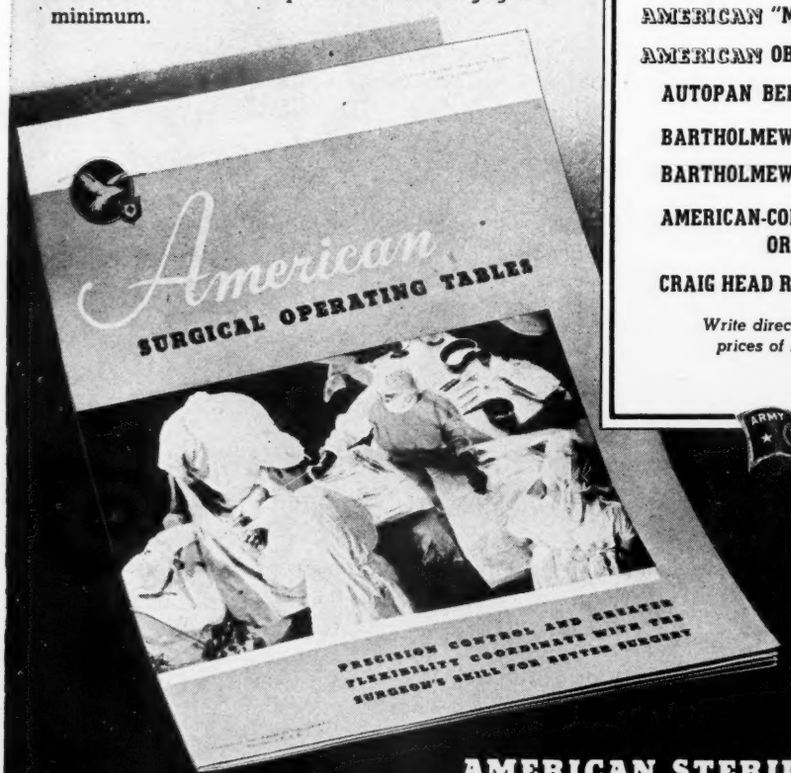
BARTHOLMEW LABOR BED •

BARTHOLMEW EYE BED

AMERICAN-COMPER INVALID and ORTHOPEDIC WALKER

CRAIG HEAD REST for UPRIGHT NEUROSURGERY

Write direct for literature, specifications and prices of Equipment under consideration.


American
SURGICAL OPERATING TABLES
PRECISION CONTROL AND GREATER FLEXIBILITY COORDINATE WITH THE SURGEON'S SKILL FOR BETTER SURGERY

AMERICAN STERILIZER COMPANY
Erie, Pennsylvania

DESIGNERS AND MANUFACTURERS OF SURGICAL STERILIZERS, TABLES AND LIGHTS

Number Five
of a Series

UNIFORM, DEPENDABLE ABSORPTION

Optimum Tissue Tolerance with Curity Catgut

Balanced Quality

MINIMAL IRRITATION

IDEAL STRAND SURFACING

ADEQUATE TENSILE STRENGTH

PLIABILITY

GAUGE UNIFORMITY

STERILITY

Curity Catgut Sutures assure the surgeon optimum wound healing with minimal tissue irritation.

The major tissue irritants—residual anhydrous sterilizing medium and free chromic salts—have been reduced to insignificant minimums.

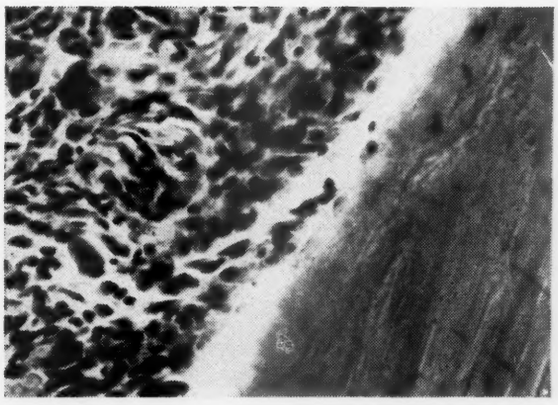
After independent and Curity Suture Laboratory research proved residual anhydrous sterilizing medium to be a major tissue irritant, manufacturing processes were developed that minimized this residue to insignificance in Curity Sutures.

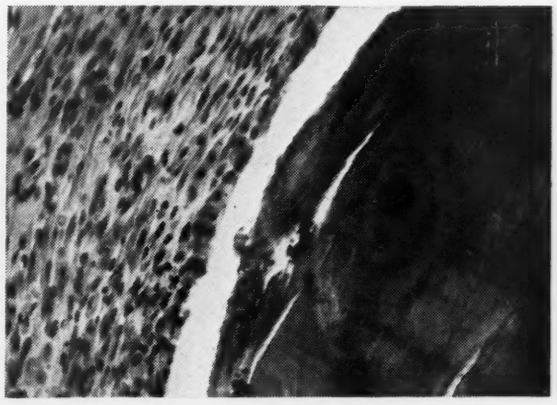
Free chromic salts have been eliminated from Curity Chromic Catgut through the development of improved processes designed to attain the optimum chrome collagen complex, and to eliminate soluble chrome compounds.

Convincing evidence that Curity Catgut Sutures cause minimal tissue irritation is shown in the photomicrographs below.

★ ★ ★

In addition to minimal irritation, weighted excellence in all other important characteristics is built into Curity Catgut. Thus Balanced Quality is maintained.





Photomicrographs showing tissue reactions to Curity No. 1 Medium Chromic Nonboilable Catgut Sutures 7 and 14 days after implantation in the gluteal muscle of rabbits. Mag. 260X.

7 Days—Microphages and fibroblasts predominate with very few leucocytes present, showing minimal tissue irritation.

14 Days—Complete absence of leucocytes, indicating disappearance of acute tissue irritation.

Curity Suture Laboratories

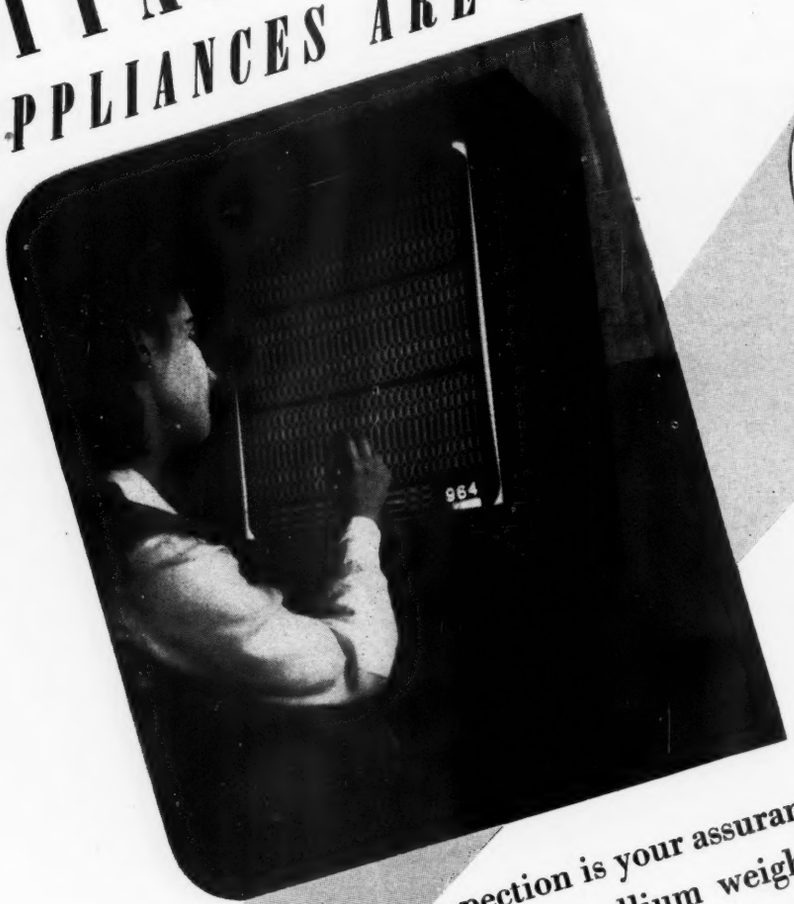
BAUER & BLACK

Division of The Kendall Company, Chicago 16

SUTURE RESEARCH . . . TO ESTABLISH A FINE BALANCE OF NECESSARY CHARACTERISTICS

Curity
REG. U.S. PAT. OFF.
SUTURES

VITALLIUM
APPLIANCES ARE X-RAY INSPECTED



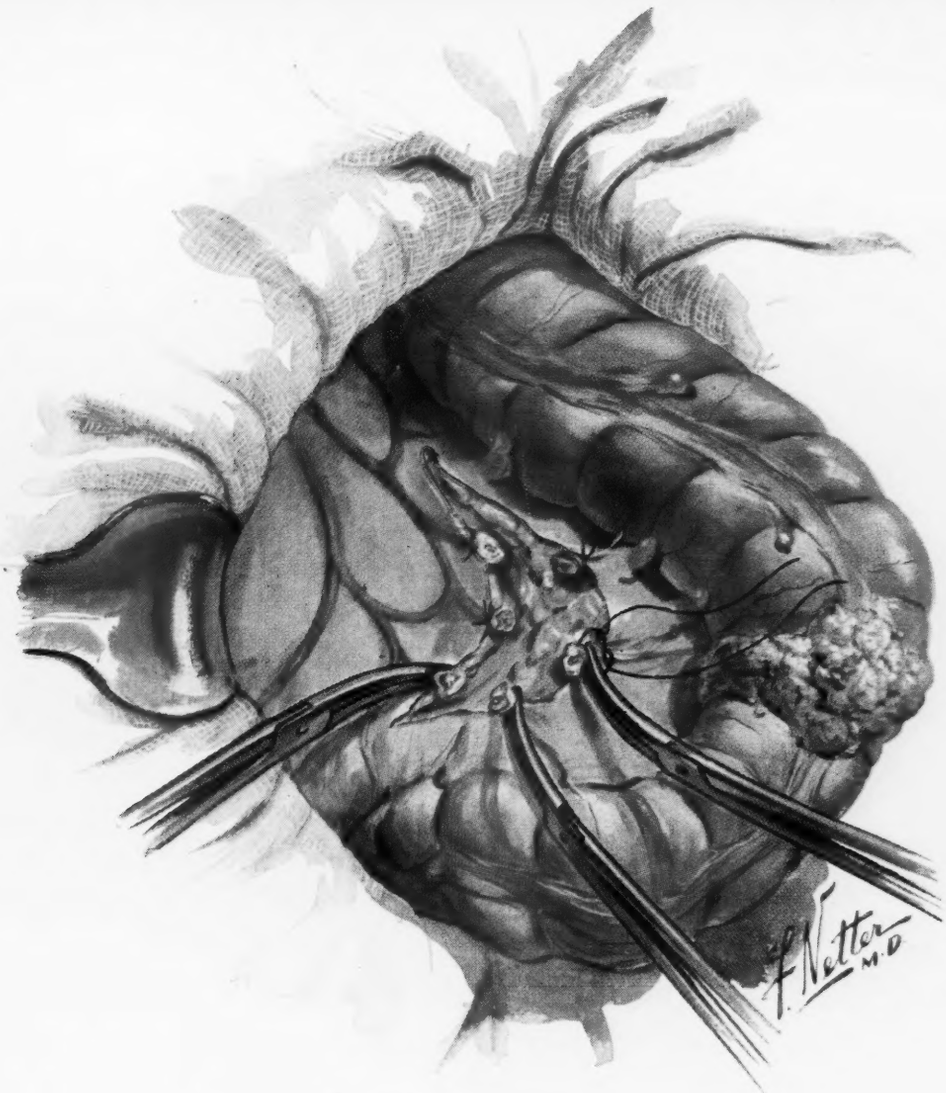
MICROCAST ★ VITALLIUM ★ TECHNIQUE

X-Ray inspection is your assurance of the requisite strength in Vitallium weight-bearing appliances. Vitallium appliances are available for internal fracture fixation, arthroplasty, bone and cartilage replacement, and internal duct repair. All Vitallium appliances are inert in the body and compatible with bone and tissue.

ORDER FROM YOUR DEALER

★ TRADEMARK REG. U. S. PAT. OFF.

AUSTENAL LABORATORIES, INC. NEW YORK CHICAGO



Obstructive Resection for Carcinoma of the Sigmoid

A surgeon when performing such arduous surgery as a resection of the large bowel, demands full confidence in the suture material at his disposal.

Sterility—Strength—Pliability and Uniformity are pre-requisites.

The suture must tie down firmly and securely —must resist absorption without undue tissue reaction.

Actual usage of Armour Sutures and Ligatures will assure the surgeon of these necessary requirements.

Armour's Sutures are gladly offered for surgical trial on request.

SUTURE DIVISION

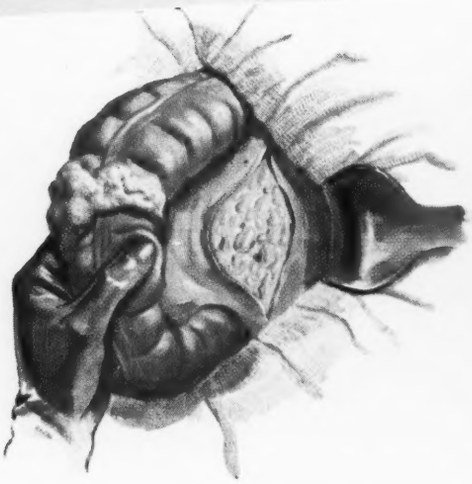
THE ARMOUR LABORATORIES • CHICAGO 9, ILLINOIS

Obstructive Resection for Carcinoma of the Sigmoid... *Operation: Two Stages*

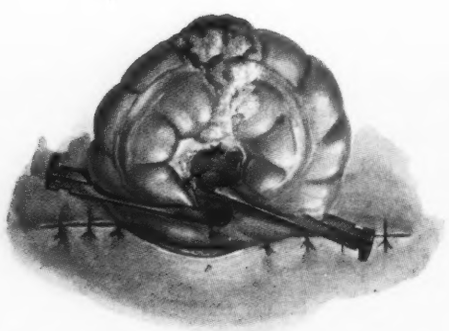
FIRST STAGE: Resection of tumor and formation of spur.

SECOND STAGE: Closure of colostomy after spur has been crushed.

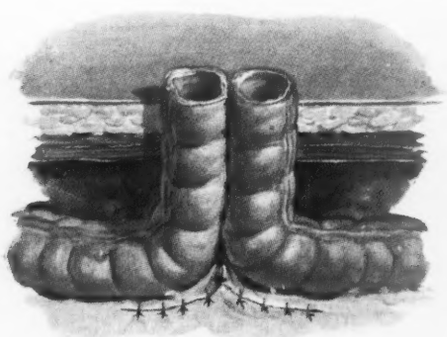
I: Sigmoid bearing tumor exposed through left lower rectus incision. Meso-colon incised and divided with ligation of branches of sigmoidal vessels.



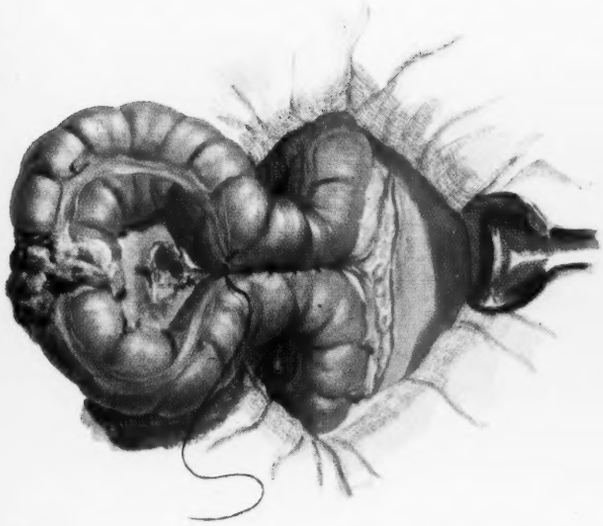
II: Mobilization aided by incision of lateral parietal peritoneum.



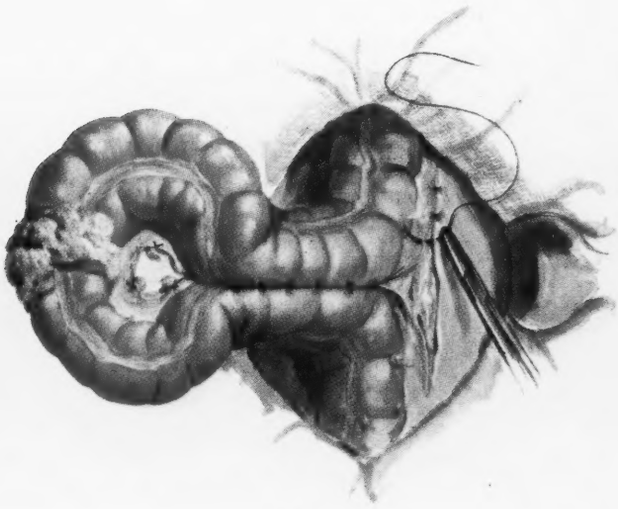
V: Abdominal wall completely closed. De Martel clamps applied. Bowel will be severed between these and crushing clamps.



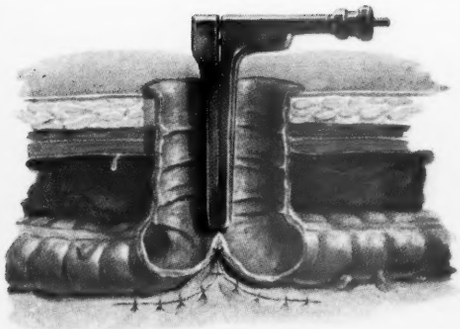
VI: Completed double-barrel colostomy after tumor bearing sigmoid has been removed.



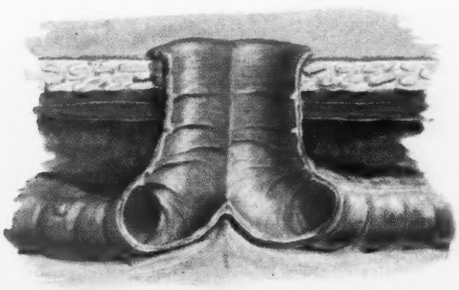
III: Spur formed uniting both limbs of sigmoid with interrupted sutures bringing antimesenteric borders together mesially.



IV: Same, completed with closure of parietal peritoneum of lumbar gutter.



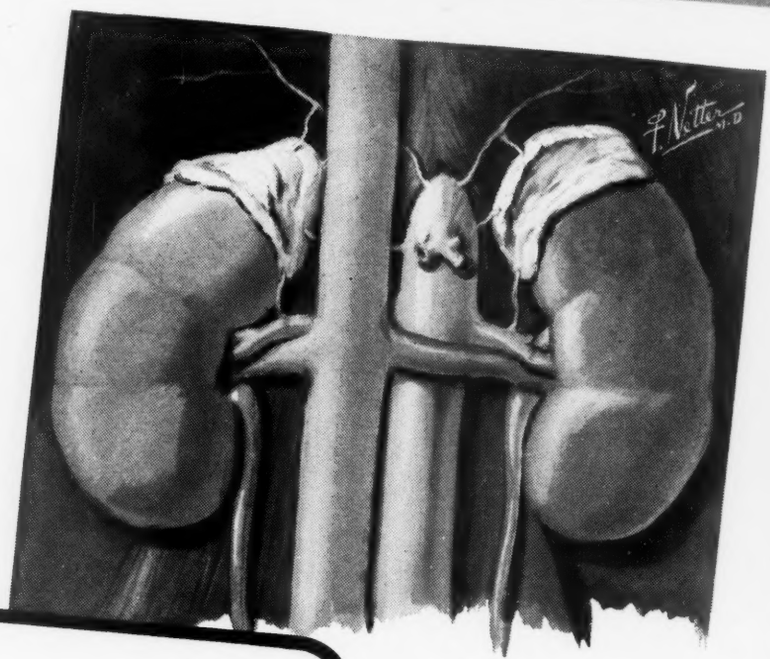
VII: About three weeks later, spur crushing clamp applied.



VIII: Spur crushed establishing continuity of bowel. Patient will return in one month for closure of colostomy. (*See later series.*)

Armour Sutures and Ligatures

the "FIGHT GLANDS"



The suprarenals have been nicknamed the "fight glands" because the secretion of the suprarenal medulla, in a sense, mobilizes the body for action. This secretion also has tremendously valuable therapeutic applications. In asthmatic paroxysm, angioneurotic edema, urticaria, anesthesia accident, asphyxia, nitritoid crisis and a number of other conditions, it often affords great relief to the patient and may at times be life-saving. In employing so potent a physiologic agent it is important that you have confidence in the product you administer. Behind SUPRARENALIN (epinephrine) ARMOUR are fifty-eight years of experience in the manufacture of endocrine preparations. Armour technicians know how to judge and select animal glands. Armour chemists are skilled in preparing endocrine medicinals and, most significant of all, they have available the world's largest supply of fresh raw material from which to choose the best.

Rx Suprarenalin Armour
(epinephrine hydrochloride U.S.P.)

Accepted by the Council on Pharmacy and Chemistry of the American Medical Association.

Available in these forms:

Suprarenalin Solution 1:1000
Supplied in 1 cc. ampoules and 1 oz. rubber-capped vials.

Suprarenalin Crystals
Supplied in 1 grain vials.

Suprarenalin Inhalant 1:100
Supplied in ¼ oz. and 1 oz. bottles for oral inhalation.

Suprarenalin Solution 1:10,000
1 cc. ampoules for hypodermic or intravenous use.

Have confidence in the preparation you administer—specify ARMOUR

THE ARMOUR LABORATORIES
CHICAGO 9, ILLINOIS

HEADQUARTERS FOR MEDICINALS OF ANIMAL ORIGIN

The Coryllos Thoracoscope

WITH SELF-CONTAINED CAUTERY AND LIGHT TRANSFORMER

600A as illustrated with footswitch and cautery-light transformer. The biopsy forceps illustrated in lid of case is an accessory instrument and is sold separately.

Biopsy Forceps, Cat. No. 389

A sturdy portable instrument for the double cannula pneumonolysis technique, which adequately meets the requirements of the American surgeon. The Coryllos Thoracoscope consists of telescope, two cannulae, light carrier, two extra lamps and sterilizable lighting cord. The long and short cautery electrodes are equipped with ventilating shields which permit air circulation in the pleural cavity. The self-contained cautery and light transformer obviates the necessity of purchasing relatively expensive high-frequency generators and transformers. The instrument is contained in a polished, substantial walnut case with carrying handle. A space is provided for the footswitch which is included.

Supplementary instruments such as curved electrodes, flexible cannula, transilluminator and aspirating tube, biopsy specimen forceps, infiltration needle, etc. are also available for those who desire a more elaborate armamentarium.

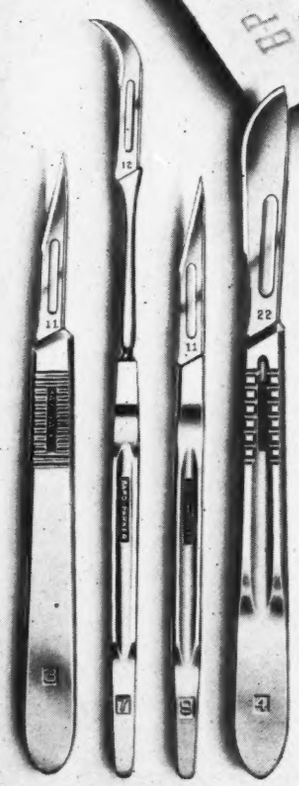
Consult your Dealer or Write to us for Literature

WAPPLER A·C·M·I· TRADE MARK

AMERICAN CYSTOSCOPE MAKERS, INC.

1241 LAFAYETTE AVENUE, NEW YORK 59, N. Y.

Prelude to *Successful Surgery*



RIB-BACK BLADES

are recognized the world over as possessing a degree of uniformity indispensable to the attainment of desired functional efficiency in surgery.

Each and every blade provides—

Uniform sharpness throughout the entire length of the cutting edge.

Uniform resistance to lateral pressure by virtue of the exclusive Rib-Back principle of blade reinforcement.

Uniform fabrication which insures firm and accurate attachment to Bard-Parker Handles.

Uniform pre-war qualities that have suffered no wartime change.

Ask your dealer

BARD-PARKER COMPANY, Inc.
Danbury, Connecticut

A BARD-PARKER PRODUCT

From heavy to delicate suturing...

Surgeons employing the Singer Surgical Stitching Instrument find that its versatility in simplifying difficult suturing techniques heralds it as one of the most important contributions to modern surgery. With the advent of the new smaller "Model A-11", the adaptability of the instrument has been extended to cover the entire range of suturing requirements. • The Singer suturing instrument, for instance, utilizes needles up to the *largest size*, or down to the *smallest size practicable* in surgical work... permits the use of *a wide range of suture material*—fed from a continuous spool supply... *speeds* the execution of old familiar stitches... and provides for *new* suturing procedures as well.

SINGER SURGICAL STITCHING INSTRUMENT

Unites needle, holder, suture supply and severing edge in one, self-contained instrument, sterilizable as a complete unit.

COPYRIGHT, U. S. A., 1945, BY THE SINGER MANUFACTURING CO. ALL RIGHTS RESERVED FOR ALL COUNTRIES.

For the complete story, use the coupon for your copy of an illustrated booklet.

SINGER SEWING MACHINE COMPANY
Surgical Stitching Instrument Division
149 Broadway, New York 6, N. Y. A-105

Without obligation please send copy of illustrated booklet.

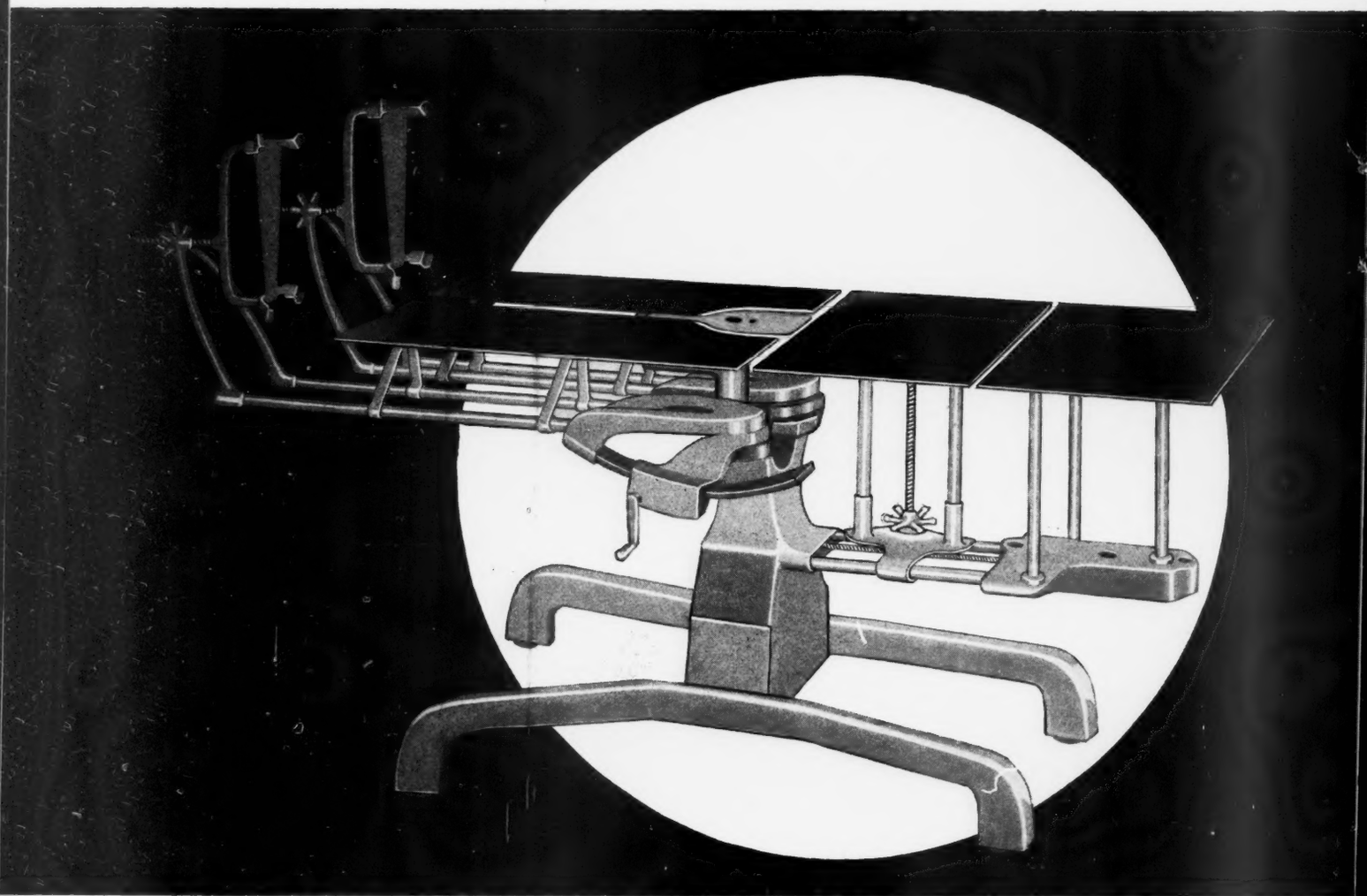
Name_____

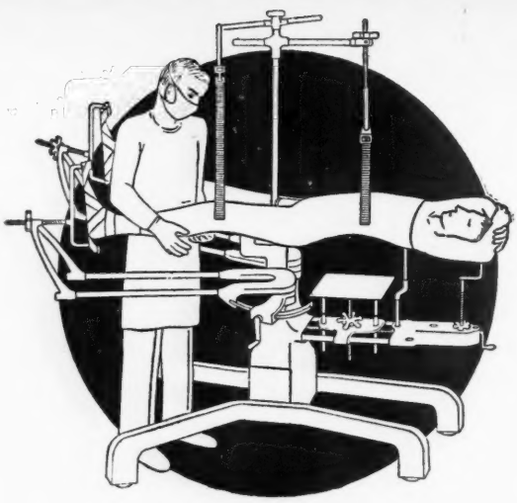
Address_____

City_____ State_____

THE ROGER ANDERSON FRACTURE TABLE

FOR ORTHOPEDIC AND GENERAL SURGICAL WORK





Application of a large double spica cast. The special occiput and interscapular supports are easily removable from body, shoulder or head casts.

Write for illustrated folder. Place your order **NOW** *to insure that your hospital will be among the first to be supplied.*

Why Not Equip Your Surgery With the Latest and Best?

This light but strong aluminum table is streamlined for beauty and efficiency. It provides for all fracture, orthopedic and surgical procedures: hip nailing, skeletal and all other types of traction including vertical, transverse and longitudinal spinal traction, hyperextension of spine, and application of all casts. The addition of a mattress converts it into a general surgical table.

The leg traction frames operate independently of each other, supplying flexion, extension, abduction, adduction and rotation all upon the anatomical centers. They also swing apart to permit placement of X-ray machine, and to allow assistant to stand between the legs while operating.

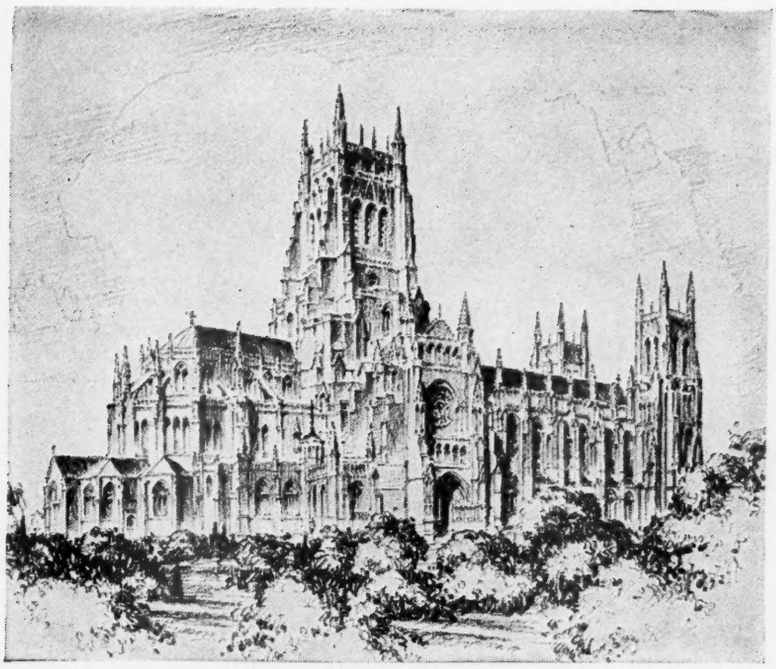
Other notable advances. Positioning in the true and reverse Trendelenburg, a transparent plastic perineal post, the quickly adjusted foot straps, special cassette holder for hip radiography, and unique head, face and shoulder supports.

The TOWER COMPANY, Inc.

Manufacturing and Research Specialists in Fracture Equipment

HOME OFFICE: 1008 Western Avenue, Seattle 4, Wash.—MAin 4443

SURGICAL DISTRIBUTORS, INC.: 120 South La Salle Street Bldg., Chicago 3, Illinois. Phone: State 8456
1681 University Avenue, St. Paul 4, Minnesota. Phone: Nestor 5872
38 Park Row, New York 7, New York. Phone: Barclay 7-6492



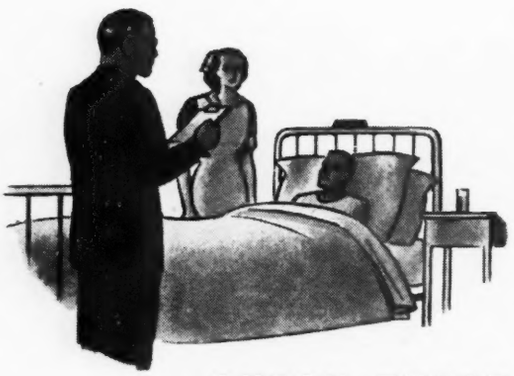
CATHEDRAL OF ST. JOHN THE DIVINE . . . on historic Morningside Heights in New York City . . . will be, when completed, the largest, most magnificent Gothic cathedral in the world. One of its noblest architectural concepts is a group of chapels symbolizing the peoples of the earth gathered around the altar of the Savior in a spirit of human brotherhood.

Perfection IN ITS FIELD . . .

THE CATHEDRAL OF ST. JOHN THE DIVINE . . . because of its majesty and grandeur . . . is considered by many experts to be one of the world's most perfect examples of ecclesiastical architecture. And as the beauty of this imposing edifice has won the admiration of people the world over, so, too, in the field of surgery, the technical perfection of instruments bearing the name SKLAR has won the profession's respect and confidence. Made by highly-trained craftsmen . . . of the very finest materials . . . every detail carefully worked out by intensive research . . . SKLAR products are especially designed to meet the modern surgeon's most exacting needs. That's why SKLAR instruments are preferred by so many famous surgeons . . . why the J. SKLAR MANUFACTURING COMPANY is today the leader in a highly specialized industry. *All SKLAR products are sold only through accredited surgical supply distributors.*

A catalog of Sklar Stainless Steel instruments will be provided on request.

Sklar LONG ISLAND CITY, N. Y.



CHECK THESE SIX ADVANTAGES OF THE CHAMPION DERMAL SUTURE

- softness and pliability for ease in handling
- *non-adherence* to skin
- absence of cracking or fraying—lessening possibility of wound disruption or breakage when knots are tied
- easy tying and non-slippage of knots
- stitches removed with minimum of discomfort
- safety against tissue reaction and wound infection

This combination of qualities makes Champion Dermal Sutures ideally suited for all forms of surface surgery, including the most delicate plastic suturing. Fineness of diameter helps to minimize scar tissue.

Champion Dermal Sutures are made of fine quality silk, by the exclusive Gudebrod process, under rigid laboratory control.

For all forms of buried suturing, Champion Paré Serum-Proof Sutures are acclaimed by leading surgeons.

Operating lengths of either or both types of sutures will be sent free on request.

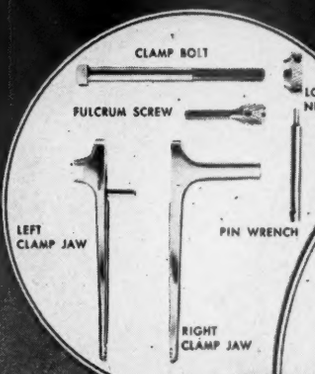
CHAMPION DERMAL
SILK SUTURES
GUDEBROD BROTHERS SILK CO., INC.
12 SOUTH 12th STREET, PHILADELPHIA 7, PA.
NEW YORK • BOSTON • LOS ANGELES • CHICAGO

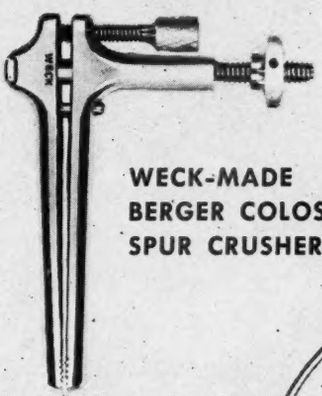
GUDEBROD BROS. CHAMPION

MANY SURGEONS NOW PREFER THE MINTRAUMATIC SUTURE — NEEDLE SWAGED TO END OF A SINGLE STRAND. WRITE FOR INFORMATION.

Today's Newest ... in Intestinal Operative Circles

Designed by Dr. Louis Berger
Attending Surgeon
Gastrointestinal Service
Jewish Hospital
Brooklyn, N. Y.

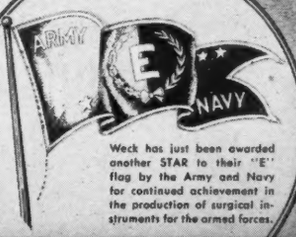




WECK-MADE BERGER COLOSTOMY SPUR CRUSHER

Send for free illustrated reprint from **AMERICAN JOURNAL OF SURGERY** *describing the Berger Spur Crusher in detail.*

The unique construction of this instrument does not permit rotation or separation of the tips of the clamp and thus assures uniform pressure on spur. It is simple of application from both the standpoint of the surgeon and the patient. Daily, during the crushing process, it may be adjusted with ease. It is light in weight, and protrudes only one inch from the abdomen. $15. complete in Stainless Steel.



Weck has just been awarded another STAR to their "E" flag by the Army and Navy for continued achievement in the production of surgical instruments for the armed forces.

Edward Weck & Co., Inc.

Founded 1890

Manufacturers Surgical Instruments

SURGICAL INSTRUMENT REPAIRING • HOSPITAL SUPPLIES

135 Johnson Street — Brooklyn, N. Y.

Aimed at

AVAILABLE in packages of 24 tablets, sanitaped, in slip-sleeve prescription boxes.

IMPORTANT: Please note that your patient requires your prescription to obtain this product from the pharmacist.

" . . . topical application insures drug concentration to a degree not attainable by other routes of administration, a point which places sulfonamide therapy by means of chewing vehicles, as discussed by Pfeiffer and Holland, on a logical basis."

— Editorial: Naval Med. Bulletin, (April) 1945, p. 862.

the site of oropharyngeal infections

White's SULFATHIAZOLE GUM*

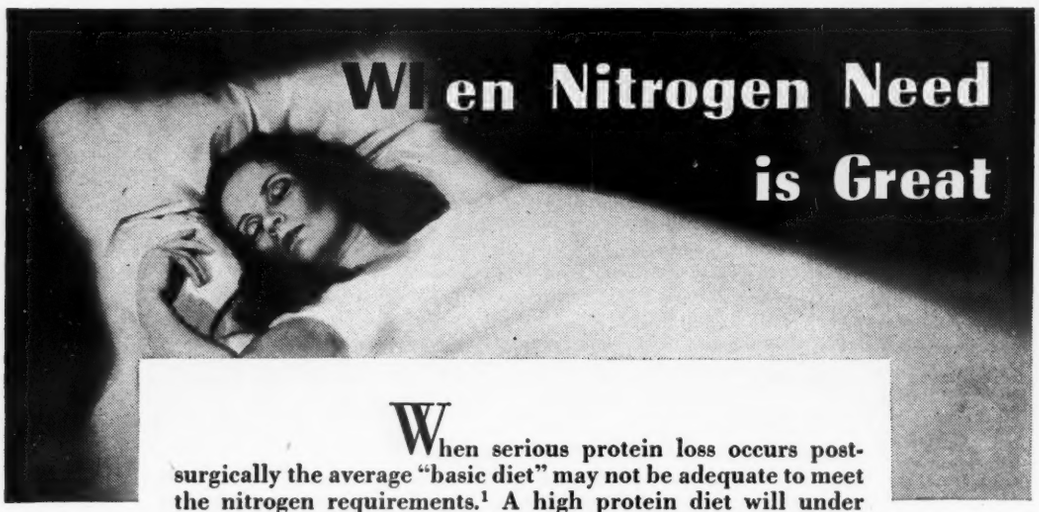
provides an efficient and practical method of effecting *immediate* and *prolonged* topical chemotherapy in oropharyngeal areas not similarly reached with gargles, sprays or irrigations.

Even a single tablet chewed for *one-half to one hour* provides a salivary concentration of locally active sulfathiazole averaging 70 mg. per cent. Moreover, resultant blood levels of the drug, even with maximal dosage, are so low (rarely reaching 0.5 to 1 mg. per cent) that systemic toxic reactions are virtually obviated.

INDICATIONS: Local treatment of sulfonamide-susceptible infections of oropharyngeal areas: acute tonsillitis and pharyngitis—septic sore throat—infectious gingivitis and stomatitis—Vincent's infection. Also indicated in the prevention of local infection secondary to oral and pharyngeal surgery.

DOSAGE: One tablet chewed for *one-half to one hour* at intervals of one to four hours, depending upon the severity of the condition. If preferred, several tablets—rather than a single tablet—may be chewed *successively* during each dosage period without significantly increasing the amount of sulfathiazole systemically absorbed.

*A product of WHITE LABORATORIES, INC., Pharmaceutical Manufacturers, Newark 2, N. J.



When serious protein loss occurs post-surgically the average "basic diet" may not be adequate to meet the nitrogen requirements.[1] A high protein diet will under certain conditions replace the nitrogen losses but when the necessary intake level cannot be reached or such a diet is not tolerated in sufficient quantity, supplementation becomes necessary.

Inadequate protein intake and depleted reserves have a relation not only to such concomitants of surgery as anesthetic damage, shock and wound healing, but also to resistance to infection, since protein is intimately linked with the mechanism of natural resistance as well as with the production of antibodies.[2]

When nitrogen need is great and supplementation becomes necessary, AMINOIDS* may be depended on as a source of readily assimilable amino acids, including those indispensable for the maintenance of human nitrogen balance, as determined by Rose.[3]

AMINOIDS, a protein hydrolysate product derived by enzymic digestion from beef, wheat, milk and yeast, is soluble in hot or cold liquids. It is palatable, thus assuring ready patient acceptance.

Two tablespoonfuls of AMINOIDS t. i. d. provide approximately 24 grams of protein as hydrolysate.

Available in bottles containing 6 ounces.

ACCEPTED AMERICAN MEDICAL ASSN. Council on Foods and Nutrition

Aminoids

REG. U. S. PAT. OFF.

A PROTEIN HYDROLYSATE PRODUCT

For Oral Administration

[1]Co Tui, et al: Ann. Surg., 121:228, 1945.
[2]Cannon, P. R., et al: Ann. Surg., 120:514, 1944.
[3]Rose, W. C., et al: J. Biol. Chem., 146:683, 1942; 148:457, 1943.

*The word Aminoids is the registered trademark of The Arlington Chemical Company.

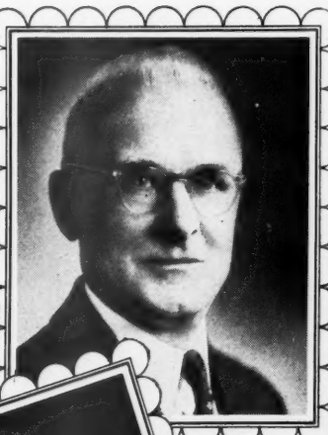
THE ARLINGTON CHEMICAL COMPANY
YONKERS 1 NEW YORK
Arlington

Technical Achievement

. . . BEHIND THE SCENES

To our organization members, whose skills and devotion to a tradition have helped to maintain Kny-Scheerer instrument standards of quality, workmanship and service through 50 years of peace and wartime service, we express our humble gratitude—and the deserved acknowledgment of the surgical profession.

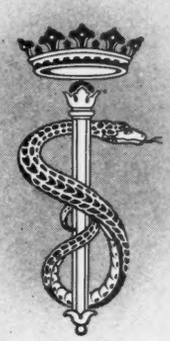
Four personalities, for instance, whose combined services total 153 years . . .



E. O. HABELSHOFER
since 1903

G. BAUER
since 1898

ROBERT E. HENRY
since 1919



JOHN P. DOYLE
since 1907

Little wonder that the K-S trademark is a recognized symbol of correctness of design, undeviating accuracy and functional dependability.

Available through leading dealers everywhere

KNY-SCHEERER CORPORATION

21-09 Borden Avenue **Long Island City 1, N. Y.**

THOUGH SURGERY IS THE PRIMARY INDICATION...

Not only in the presence of infection, but also as a guard against the development of complicating infection, penicillin has proved a valuable aid to the surgeon. Though surgery may be the primary measure called for, in many instances the preoperative administration of penicillin improves the surgical outlook; at surgery and thereafter, the combined local and parenteral use of penicillin frequently has proved effective in lessening the stormy aspects of the postoperative period.

Local instillation of penicillin (200,000 units in 48 hours), into the abdominal cavity, produced "dramatic effect" in a 5 year old child. This "would otherwise have been a hopeless case of acute appendicitis, with perforation, gangrene, and general peritonitis." Striking recovery began after 24 hours.

Kalisova, M.: Brit. M. J. 2:597 (Nov. 4) 1944.

•

Eighteen cases of minor surgical infections were treated with 1 or 2 local penicillin instillations (500 O. U. per cc. of isotonic saline). Spectacular recovery resulted.

Waldman, S.: Indust. Med. 13:997 (Dec.) 1944.

•

Local penicillin instillation (500 O.U. per cc.) in a total dosage of 35,000 O.U. in 5 days, combined with wound suture at an early stage, was successful in 60 of 62 war wounds associated with fracture. Penicillin given parenterally (480,000 units in 4 days) was used in half the cases. Both series showed equally good results.

Bentley, F. H.; Thompson, S.; Bingham, A. K.; Key, J. A., and Wostenholm, M. H.: Lancet 1:232 (Feb. 24) 1945.

•

Parenteral (100,000 units daily for 10 days) and local (5,000 units at operation) penicillin therapy, together with excision of granulation tissue, resulted in successful closure of three decubitus ulcers of the back.

Lamon, J. D., Jr., and Alexander, E., Jr.: J. A. M. A. 127:396 (Feb. 17) 1945.

•

Penicillin, administered parenterally (10,000 units every 3 hours for two days preoperatively and 6 to 8 days postoperatively), permitted treatment of neural wounds within a few days after injury. Wounds healed by first intention, without complications.

Norcross, N. C.: Arch. Surg. 50:67 (Feb.) 1945.

ACCEPTED AMERICAN MEDICAL ASSN Council on Pharmacy and Chemistry

Penicillin-C.S.C. is accepted by the Council on Pharmacy and Chemistry of the American Medical Association.

PENICILLIN-C.S.C.

Rigid laboratory control in its manufacture and bacteriologic and biologic assays safeguard the potency of Penicillin-C.S.C., its sterility, nontoxicity, and freedom from fever-inducing pyrogens.

The state of purification reached in Penicillin-C.S.C. is indicated by the notably small amount of substance required to present 100,000 Oxford Units. Because of this purity, incidence of the undesirable reactions, attributed by many investigators to inadequate purification, is greatly reduced.

The large production of Penicillin-C.S.C. (more than 1,000,000 vials of 100,000 Oxford Units each per month) and ample distribution facilities assure prompt availability in every section of the United States.

PHARMACEUTICAL DIVISION

COMMERCIAL SOLVENTS

Corporation

17 East 42nd Street New York 17, N. Y.

CSC

Penicillin-C.S.C. is available in single vials (20-cc. size) of 100,000 and 200,000 Oxford Units, and in combination packages providing one vial of penicillin (100,000 O.U.) and one vial containing 20 cc. of sterile, pyrogen-free isotonic solution of sodium chloride.

HYDROSULPHOSOL

Provides all 9 desired requisites as a superior therapy in thermal, acid and caustic burns.

Provides for mechanical exclusion of air at site of burn • Insures prompt relief of pain • Aids in abating burn shock • Bacteriostatic influence • Non-toxic effect • STIMULATES TISSUE REPAIR • Rapidly reduces inflammation and edema • Results in absence or marked reduction of scar tissue • Tends to shorten convalescent period.

HYDROSULPHOSOL is a true solution of sulfur bearing compounds resulting solely from the reduction of flowers of sulfur by a catalytic process. In aqueous solution, it is capable of rapidly releasing its high concentration of sulfhydryl ion (-SH radical) in such form as can be effectively utilized by the body in the synthesis of sulfur-containing amino acids . . . functionally active in cell stimulation and directly related to tissue respiration and repair.

Unlike the sulfa group and many other sulfur compounds, Hydrosulphosol is non-toxic when administered orally or topically applied in heavy concentrations, and will not result in damage to liver and kidney function.

Reprints of scientific papers by authoritative investigators available on request.

AVAILABLE FORMS

AQUEOUS SOLUTION:
Bottles of 8 fluid ounces.

OINTMENT:
Jars of 1 lb.
Tubes of ⅗ oz.

•

ORDER TODAY through your surgical or hospital supplier.

DAVIS EMERGENCY EQUIPMENT CO., INC.
Pharmaceutical Division
76 HALLECK STREET NEWARK 4, N. J.

TWO ACE *Elastic* BANDAGES

EACH OUTSTANDING IN LONG LIFE AND THERAPEUTIC VALUE

THE ACE

ALL COTTON-WITHOUT RUBBER

No. 1 — NATURAL COLOR

(Should be compared ONLY with all-cotton elastic bandages.)

This all-cotton Ace is superior to any other all-cotton elastic bandage. Its therapeutic value has been proven in hundreds of thousands of cases of varicose veins and ulcers, strains, sprains and injuries. Made from long-fibered Egyptian cotton with properly twisted warp and weave, it has an adequate quantity of cross threads to provide substantial body. The feather edge prevents raveling or cutting by the edges and assures comfortable wear. The stretch is moderate and uniform over the full width of the bandage. Washing restores any elasticity lost in use.

THE ACE

REINFORCED WITH "LASTEX"*

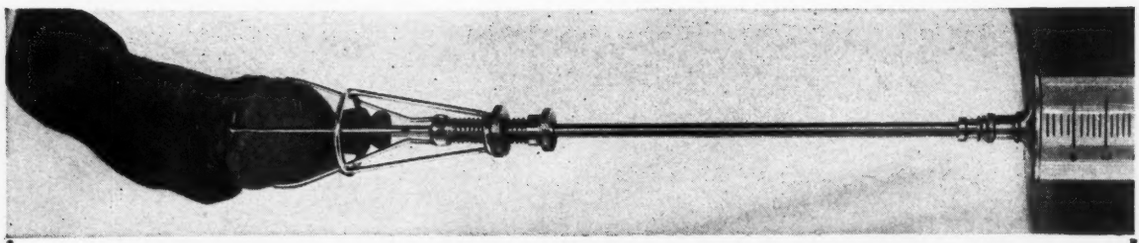
No. 8 — SKIN-TONE

(Should be compared ONLY with rubber reinforced elastic bandages.)

This Ace assures constant elasticity because it is reinforced with "Lastex" yarn. "Lastex" has the efficient qualities of rubber but eliminates the inefficient properties. Therefore, this Ace No. 8 — with "Lastex" has been designed to remain active and useful — comparatively unaffected by dealer storage, perspiration, oils, grease, and other solvents which may shorten the life and reduce the therapeutic value of bandages not reinforced with "Lastex".

* Reg. U. S. Pat. Off.

BECTON, DICKINSON & CO., RUTHERFORD, N. J.



BRODNY URETHROGRAPHIC CLAMP

Ref: "A New Instrument for Urethrography in the Male," M. Leopold Brodny, M.D., Boston. Journal of Urology, Vol. 46, No. 2, August 1941; "Enuresis—The Use of Cysto-Urethrography in Diagnosis," M. Leopold Brodny, M.D., and Samuel A. Robbins, M.D., Boston, Journal of the A.M.A., December 16, 1944.

This is the instrument demonstrated and exhibited by Dr. Brodny at the last meeting of the American Urological Association in St. Louis.

The Brodny Urethrographic Clamp was designed to improve the method customarily used in urethrography of the male, namely, manual holding of the glans penis, for the introduction of a glass syringe fitted with a rubber acorn tip to obturate the meatus and allow for the injection of the iodized oil into the urethra. The disadvantages of this method are overcome by the use of the Brodny Urethrographic Clamp in that . . .

1. **The operator's hands are not exposed to the x-ray.**
2. **There is no difficulty in obtaining a satisfactory grasp of the glans even when there is leakage of oil.**
3. **It eliminates the strain of holding the syringe in place until the films have been developed and the results checked.**

The Brodny Urethrographic Clamp can also be readily adapted for the injection of measured quantities of medication into the urethra. Here it has the additional advantage of preventing staining of the physician's or the patient's hands.

The Clamp consists of four T-shaped limbs with rubber-covered tips, shaped to conform to the longitudinal contour of the glans. The spring steel limbs can be adjusted to fit any size glans. Through the center of the limb arrangement a cannula with a rubber acorn tip on one end and a syringe on the other end can be pushed distally until the acorn tip enters and completely obturates the meatal opening. The cannula is immobilized by a turn of a lock nut. The cannula is 8¼ inches long.

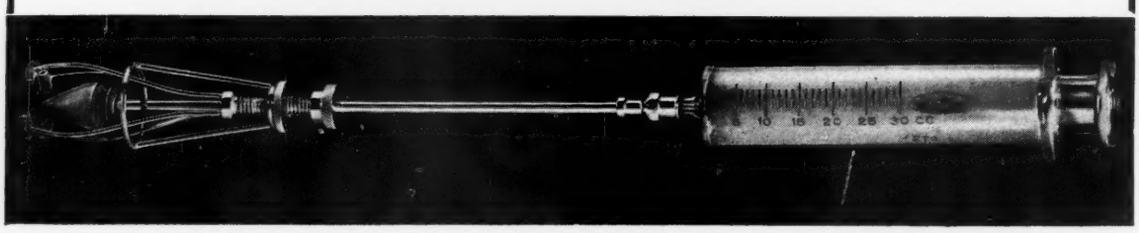
D-950 BRODNY URETHROGRAPHIC CLAMP with rubber acorn tip — Each $12.50

D-951 BRODNY URETHROGRAPHIC CLAMP OUTFIT, complete with rubber acorn tip and 30 cc. Gold Seal Hypodermic Syringe, with large-to-small Luer adapter — Each $16.50

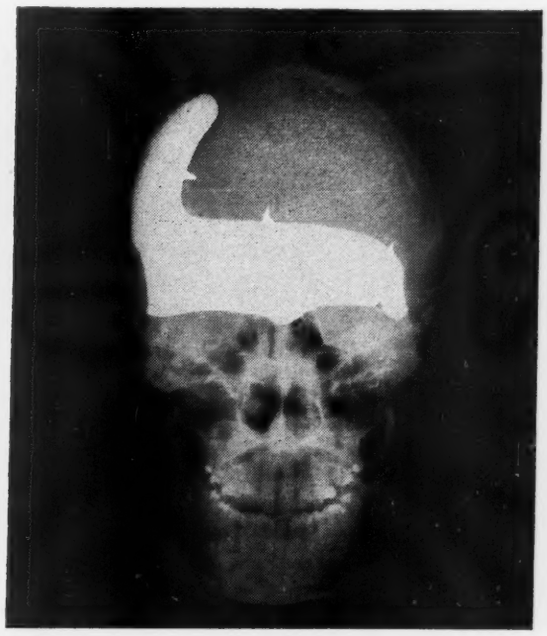
Order from your surgical supply dealer

CLAY-ADAMS CO INC.

44 EAST 23rd STREET, NEW YORK, N. Y.



Primary repair of uncomplicated skull defect with preformed tantalum plate.



Secondary repair of deforming frontal defect by preformed tantalum plate.

Tantalum plating of skull defects

"THE repair of skull defects caused by war wounds or incidental to casual illness among service personnel has become a major responsibility of the military neurosurgeon," according to Hemberger, Whitcomb and Woodhall, at Walter Reed General Hospital.†

"The strength, malleability and inertness of tantalum in tissue," say the authors, "have recommended its use in skull defect repair."

* * *

• For skull repair, tantalum is supplied in sheets, wire, and sutures. Literature on request.

† Hemberger, A. J.; Whitcomb, B. B., and Woodhall, B.: The Technique of Tantalum Plating of Skull Defects, J. Neurosurg. 2: 21-25 (Jan.) 1945.

Tantalum is now available through surgical dealers

ETHICON
Sutures

For Every Surgical Procedure

ETHICON SUTURE LABORATORIES

DIVISION OF JOHNSON & JOHNSON, NEW BRUNSWICK, N. J.

"One must be ready to improvise"

said Major Joppolo of his problem in Adano

To the simple folk of Adano a bell was all-important. Here, equally significant in city or village is the doorbell of the physician. Even the most resourceful doctor may feel "up against it" if in answer to the bell, the problem is to remove impacted or superficially placed foreign particles in the eye, without making the procedure an ordeal for himself as well as the patient. ● So that they *will* be ready at all times for such emergencies, many physicians make it a point to keep Butyn Sulfate 2% Solution on hand. A few drops of this highly efficient topical anesthetic provides an anesthesia so rapid that simple operations may be started *within one minute.* ● Compared to cocaine, the anesthesia produced by Butyn Sulfate is *more rapid* and *more profound* in *the quantity required.* It does not dry the conjunctiva, affect accommodation or intraocular tension and seldom causes pupillary dilation. Solutions of Butyn Sulfate are stable and are not decomposed by boiling. If you do not have Butyn Sulfate 2% Solution on hand for routine and possible emergency use, why not telephone your pharmacist for a 1-fluidounce dropper bottle . . . NOW?

No Federal Narcotic Blank is required. ABBOTT LABORATORIES, NORTH CHICAGO, ILLINOIS.

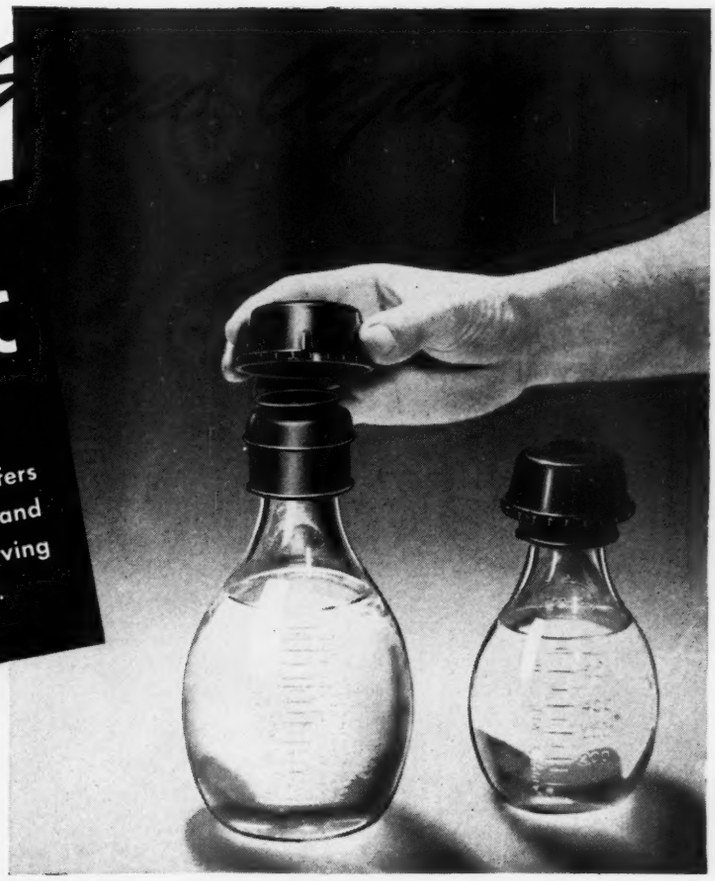
BUTYN
REG. U.S. PAT. OFF.
SULFATE
2% solution

(p-aminobenzoyl-di-butyl-amino-propanol sulfate, Abbott)

FENWAL S

THE POUR-O-VAC SEAL

A dual-function closure that offers unprecedented convenience and safety in handling and conserving surgical fluids in the hospital.



***POUR-O-VAC** seals are reusable . . . may be sterilized repeatedly.*

Will fit Fenwal 500, 1000, 2000 and 3000 ml. containers.

Fenwal

ADVANTAGES IMPORTANT TO EVERY HOSPITAL . . .

The Pour-O-Vac seal is a practical hermetic closure which permits storage of sterile fluids for long periods. Sterility may be constantly determined by the audible "water-hammer" signal.

The flaring upper lip of the collar facilitates pouring solutions directly from the original container without danger of contamination by contact with parts of the collar which are not within the sterile area of the closure. Contents will pour freely and without drip.

Serves as an efficient dust-tight seal when total contents of container are not used ▲ Eliminates waste of contents ▲ Saves time in sealing ▲ Eliminates use of cotton, gauze, string, paper, tape ▲ Markedly reduces possibility of breakage or damage to lips of containers.

ORDER TODAY or request further information.

MACALASTER BICKNELL COMPANY

243 Broadway Cambridge, Massachusetts

1. SHARPER CUTTING EDGE

2. MORE RIGID IN SERVICE

3. BETTER BALANCE

4. CLOSER UNIFORMITY

5. MORE ECONOMICAL TO USE

Consider point No. 2

CRESCENT BLADES ARE **MORE RIGID!**

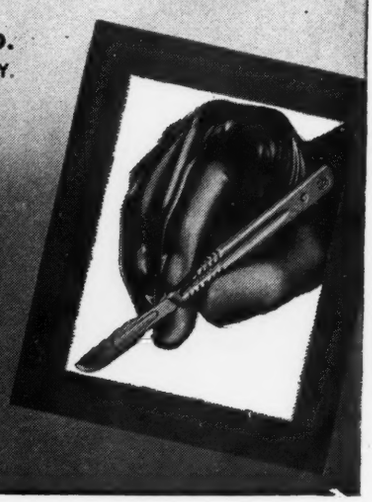
With 33-1/3 per cent more of the finest surgical steel "built into" every Crescent blade, it's no wonder that under even the toughest operative conditions, they resist any tendency to bend or weave.

For war surgery, Crescent exceeded the requirements of official "rigidity" and "deflection" tests. And, in civilian practice, evidence of their quality is the fact that they are being increasingly adopted by leading surgeons as "standard."

An unusually keen cutting edge — fine, sensitive balance — close uniformity — and marked economy: these represent other outstanding features which make Crescent truly the "master blade for the master hand!"

CRESCENT SURGICAL SALES CO.
440 Fourth Avenue • New York 16, N. Y.

THE MASTER HAND DESERVES A MASTER BLADE



Crescent

SURGICAL BLADES AND HANDLES

SINCE THE FERRET SNEEZED

Ten years have elapsed since an influenza-infected ferret in a British laboratory sneezed into the face of a research worker who promptly contracted influenza. The ferret's sneeze made it clear that flu-fighters were on the right course in their virus studies.

Since that day, much progress has been made in research directed toward the perfection of an immunizing agent that will combine those strains of virus necessary to provide protection against influenza wherever it might be met throughout the world.

For the past five years the Research Laboratories of Parke, Davis & Company have been in the forefront of studies on influenza and other respiratory diseases.

PARKE, DAVIS & COMPANY
DETROIT 32, MICHIGAN

RESEARCH IS THE OPEN SESAME TO PROGRESS

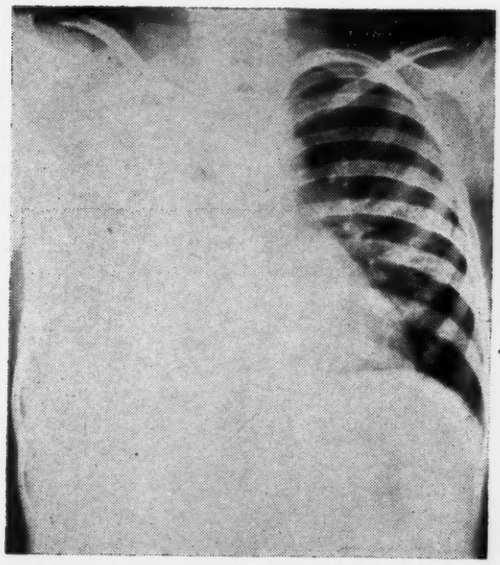
PARKE-DAVIS & CO

The need for an extract of the posterior lobe of the pituitary gland which contains the pressor and antidiuretic principles, but which is substantially free from the oxytocic principle... one which will raise the blood pressure in shock or collapse, stimulate the muscular activity of the gastrointestinal tract sufficiently to relieve postoperative abdominal distention and to eliminate intestinal gas pockets during roentgenography, and exert an antidiuretic effect in the treatment of diabetes insipidus... such was the need that is now met by the development of...

PITRESSIN

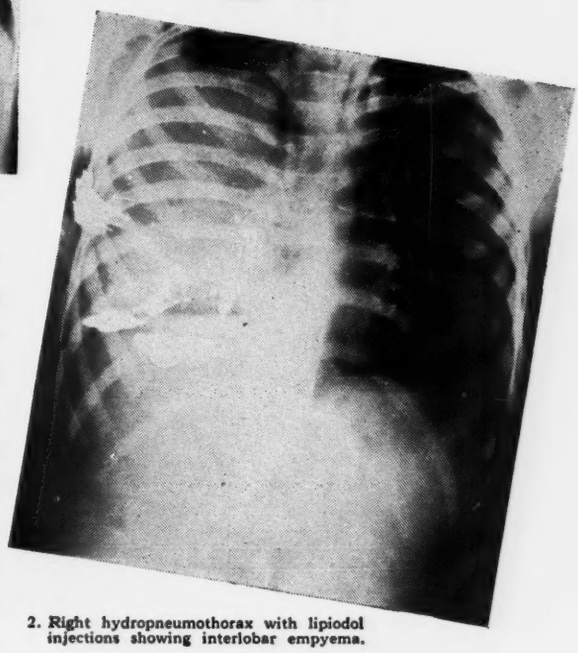
(Beta-hypophamine)

product of
PARKE, DAVIS & COMPANY
DETROIT 32, MICHIGAN



1. Right lobar pneumonia (type 1) and right empyema.

Penicillin in Empyema



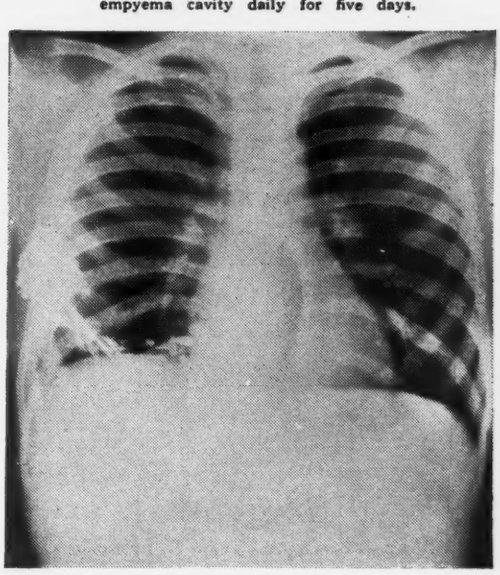
2. Right hydropneumothorax with lipiodol injections showing interlobar empyema.

Size of cavity, type of infection, and number of organisms determine the amount of penicillin to be administered in empyema. Usually 50,000 or 100,000 units in normal physiologic saline solution are injected once or twice daily directly into the empyema cavity after aspiration of pus or fluid. (Keefer, C. S.: New Dosage Forms of Penicillin, J.A.M.A. 128:1161 [Aug. 18] 1945.) Treatment is by instillation, rather than irrigation, because penicillin requires at least 6 to 8 hours of contact for maximum effect.

Bristol Penicillin, because of its freedom from toxicity and pyrogens, as well as absolute sterility and standard potency assures the desired pharmacologic action.

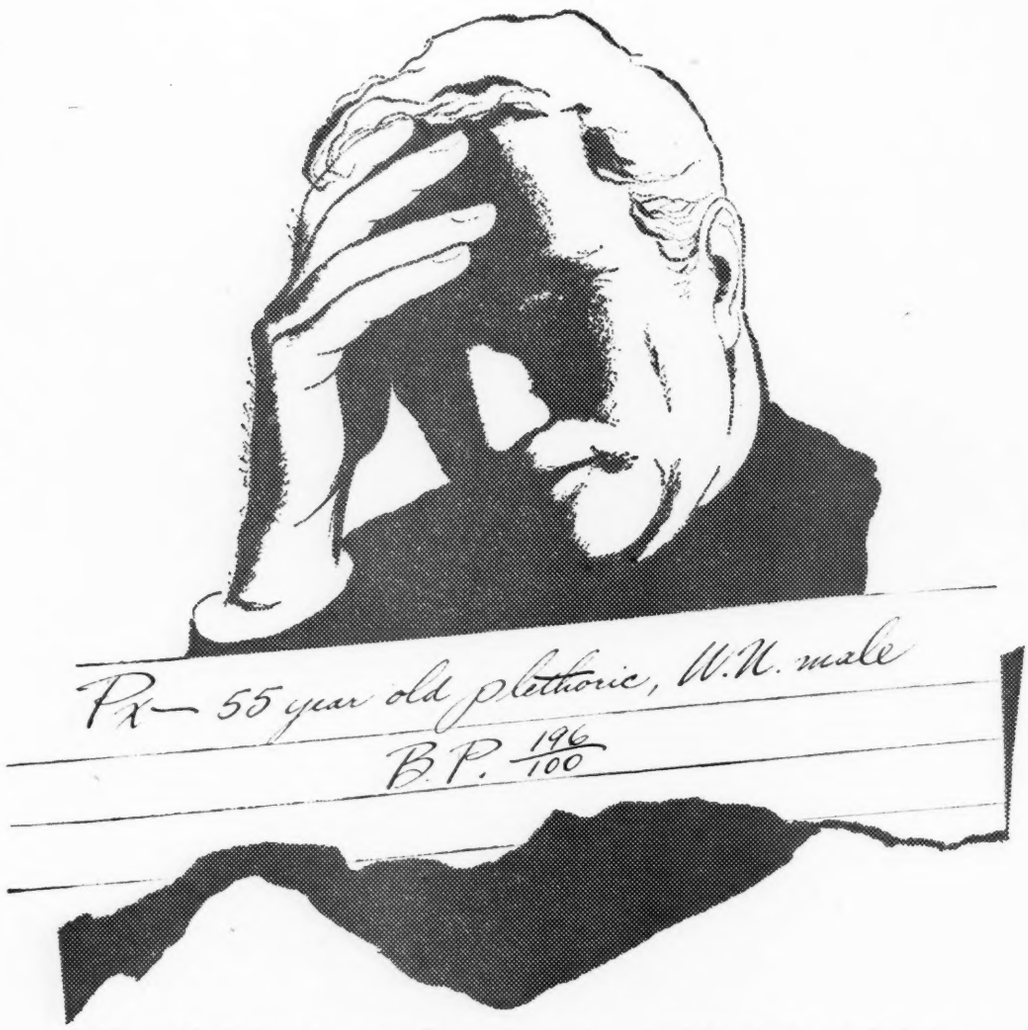
The rapidly developing new clinical uses of this potent antibiotic are abstracted in issues of the BRISTOL PENICILLIN DIGEST. If not receiving *your copies* regularly, write. Order Bristol Penicillin through your physicians' supply house.

3. After injecting Penicillin in saline into empyema cavity daily for five days.



BRISTOL
LABORATORIES
INCORPORATED

Formerly
CHEPLIN LABORATORIES INC.
SYRACUSE 1, N. Y.



Well nourished? At a glance, yes. But good nutrition cannot be gauged so easily. The hypertensive patient, like the diabetic or peptic ulcer case on a strict regime, may be bordering on nutritive failure *as a result of his special diet.* It takes careful evaluation to determine whether nutritive failure exists.

Spies[1] states: "severe atypical deficiency disease, like other forms of nutritive failure, can be successfully corrected by the application of . . . four essentials." One of these is administration of the four critical water-soluble vitamins in high dosage.

Squibb Basic Formula *is the same formula used by Spies*[1,2] and Jolliffe and Smith[3]—based on years of their clinical experience.

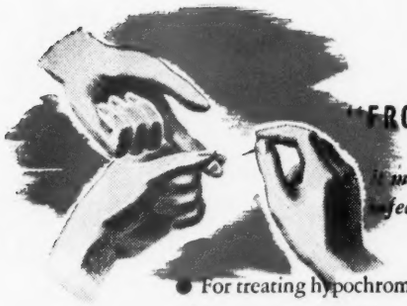
Each Squibb Basic Formula Vitamin Tablet contains: thiamine hydrochloride 10 mg., niacinamide 50 mg., riboflavin 5 mg., ascorbic acid 100 mg.

For complete information, write on your prescription blank "Nutritive Therapy" and mail to Squibb Professional Service Dept., 745 Fifth Avenue, New York 22, N. Y.

Basic Formula SQUIBB

1. Spies, Tom D.; Cogswell, Robert C., and Vilter, Carl: J.A.M.A. (Nov. 18) 1944. Spies, Tom D.: Med. Clin. N. Am. 27:273, 1943. 2. Spies, Tom D.: J.A.M.A. 122:911 (July 31) 1943. 3. Jolliffe, Norman, and Smith, James J.: Med. Clin. N. Am. 27:567 (March) 1943.

MANUFACTURING CHEMISTS TO THE MEDICAL PROFESSION SINCE 1858



"FROM A CLINICAL POINT OF VIEW...

it must be assumed that every patient with chronic infection is anemic."*

● For treating hypochromic anemias, Hemo-genin combines the advantages of Fergon (Ferrous Gluconate Stearns) with the nutritional values of vitamin B complex plus liver concentrate. Because Fergon is rarely associated with gastro-intestinal distress, Hemo-genin may be administered before meals to enhance iron absorption.

Hemo-genin

Fergon Plus B Complex

FOR HYPOCHROMIC ANEMIAS REQUIRING IRON AND B COMPLEX

Frederick Stearns & Company
Division

DETROIT 31, MICHIGAN

NEW YORK KANSAS CITY SAN FRANCISCO WINDSOR, ONTARIO SYDNEY, AUSTRALIA AUCKLAND, NEW ZEALAND

FACTS ABOUT HEMO-GENIN

COMPOSITION: Fergon (Ferrous Gluconate Stearns), synthetic vitamin B complex factors, and liver concentrate. Six capsules daily supply 12 gr. ferrous gluconate and the daily requirement of B vitamins.

NON-IRRITATING to gastro-intestinal mucosa because low degree of ionization makes it virtually non-astringent. May be administered before meals to facilitate maximum absorption.

GREATER iron utilization shown by clinical comparison of ferrous gluconate with other iron salts.†

†J. Clin. Investigation 16:547, 1937.

INDICATED in hypochromic anemias requiring iron and vitamin B complex. Especially valuable when patients do not tolerate other forms of iron.

DOSAGE: Two capsules three times daily, before or after meals.

SUPPLIED in bottles of 100 and 500 capsules.

FURTHER FACTS AND SAMPLES WILL BE GLADLY SENT ON REQUEST

*J.A.M.A. 123:1007, 1943.

TRADE-MARK HEMO-GENIN – REG. U. S. PAT. OFF.

No inflation here!

THE MONEY YOU PAID FOR
12 RED CROSS* BANDAGES
IN 1918...

...WILL BUY 16
TODAY!

While the above comparison is based on the popular 2" x 10 yd. size, *all* sizes of Red Cross Bandages show substantial savings.

THIS interesting comparison of Red Cross Bandage values during 1918 and 1945, is clear evidence of the Johnson & Johnson philosophy of giving you the highest quality products at the lowest possible cost.

Johnson & Johnson
NEW BRUNSWICK, N. J. CHICAGO, ILL.

**Trade Mark of product made exclusively by Johnson & Johnson*

The American Journal of Surgery

Copyright, 1945 by The American Journal of Surgery, Inc.

A PRACTICAL JOURNAL BUILT ON MERIT

Fifty-fourth Year of Continuous Publication

NEW SERIES VOL. LXX OCTOBER, 1945 NUMBER ONE

Editorial

EARLY AMBULATION AFTER OPERATION

WHEN James Hilton delivered the Hunterian lectures at the Royal College of Surgeons in 1861, his subject matter was a radical departure from the topics chosen by his illustrious predecessors. Heretofore, the lectures had been confined to some phase of the then basic subjects of anatomy, physiology and clinical surgery, but Hilton elected to limit his discussion to the influence of mechanical and physiological rest in the treatment of surgical disorders. These lectures were embodied in a monograph entitled "Rest and Pain," a volume that was destined to become a classic. Hilton's theme was that the guiding principle of the surgeon should be to assist nature. To quote "It would be well I think if the surgeon would fix upon his memory the first professional thought which should accompany him in the course of his daily occupation, the physiological truth that nature has a constant tendency to repair the injuries to which her structures may have been subjected."

Hilton's emphasis on rest as an adjunct to surgical intervention has had a profound influence on the after-care of surgical patients for over three-quarters of a century. Like the declamation of many famous observers, as for example Osler's "Euthanasia at 60," his ideas like the declamation of many of the famous men have been largely misinterpreted because only few have taken the trouble to study his lectures and so many have contented themselves with accepting the title alone of his book "Rest and Pain" as representing the gist of his teaching; whereas Hilton's emphasis actually was placed on physiologic rest which does not necessarily mean bed rest. Similarly William Osler's alleged championship of "Euthanasia at 60" which received such widespread newspaper publicity was based on faulty reporting, for those of us who were fortunate enough to hear his lecture on February 22, 1905, placed no such interpretation on his remarks. John Hunter, too, has also been widely quoted as advising bed rest for all diseased conditions, but as Sir Arthur Keith points out in his "Menders of the Maimed," Hunter prescribed rest only in the treatment of disablements of the motor system. Furthermore, he himself suffered from anginal attacks during the last twenty years of his life, during which period he continued at active work and produced some of his greatest contributions.

The theory and practice of continuous and prolonged bed rest after operations has been frequently challenged. Since the turn of the century most of the con-

tributions to surgical literature have been of European origin, though Ries published an enthusiastic report of his experiences with early rising in the Journal of the American Medical Association as early as 1899. Eugene Pool, in 1913, published a paper entitled "Systematic Exercise in Postoperative Treatment" in which he elaborated a definite set of exercises to be performed by the patient while still in bed. Designed primarily to prevent stagnation of blood in the venous system, and so guard against thrombophlebitis. These exercises were productive of other beneficial effects such as, diminution of muscular weakness and atrophy and the promotion of a feeling of well being in the patient. The author has employed these exercises in his practice with happiest results, since his days as House Surgeon at the New York Hospital when he was for three years associated with the originator of the method. Exercise in bed was but the forerunner of the revolutionary idea of early ambulation.

The proponents of getting patients out of bed within twenty-four hours of operation cite the following advantages: (1) Lowering of the incidence of postoperative pulmonary complications by promoting the cough reflex; (2) early movement of the legs stimulates circulation and thus prevents thrombosis; (3) stimulates early return of function to the gastrointestinal tract, thereby diminishing nausea, vomiting and distention. (4) beneficial physiologic effect on patient's morale, and (5) acceleration of convalescence resulting in a decreased period of hospitalization and earlier return to normal activities.

The rationale of the practice of early ambulation following surgical intervention has a very practical foundation. It is based on the observation that the postoperative course of children who cannot be restrained, of elderly people who are gotten out of bed immediately after operation to prevent pulmonary complications, and of those rugged individuals who insist on immediate bathroom privileges, are not adversely affected by early motion. In fact, they usually get along extremely well, often providing "seven day wonders" for conventionally minded nurses and house staff. The absence of ill effects following early rising was brought to our attention thirteen years ago when a sixty-nine-year old male went to the bathroom the evening of operation for strangulated femoral hernia, and continued to do so throughout his ten-day stay in the hospital. His hernia has remained cured and the scar is scarcely visible.

Though the application to surgical practice of the principle of early ambulation as exemplified in the foregoing groups of patients seems like such a short step, actually it has been more of the nature of a long jump. It remained then for Daniel J. Leithauser to put into everyday practice this revolutionary method in postoperative care. He has reported a series of 1,300 patients subjected to over thirty different surgical procedures including splenectomies, gastrointestinal operations, etc., in which the patients were gotten out of bed on the day of operation, or the first postoperative day. His experiences with this type of treatment have been excellent. There were only three deaths in the series, no one of which could be attributed to early activities. Complications were few. There was only one case of wound dehiscence, and one of thrombophlebitis. There were no incisional hernias, but there were five recurrences in seventy assorted herniorrhaphies. The elimination of serious pulmonary complications is credited to the stimulation of the cough reflex which occurs when the patient assumes the erect position. One has only to view Dr. Leithauser's motion picture film to become convinced of the great value of this observation. In a series of views depicting early rising after operation an obese female is seen standing up beside the bed on the day of operation. Immediately on assuming the erect position she

begins to cough and expectorates several ounces of thick tenacious mucus. The dire effects of retaining the secretion and the difficulties of promoting its evacuation by other methods are so familiar to those responsible for postoperative care that further comment is not required. Dr. Leithauser's results based on extensive experience with early ambulatory activity are impressive. If his plan is adopted, he counsels against long vertical incisions and dependence on non-absorbable sutures. He advises transverse or short vertical incisions and the use of non-absorbable sutures. His work is a distinct contribution to postoperative care which merits further consideration and trial.

Roy D. McClure, M.D.

Patients with fractures of the lower limb never should be transported until after splinting has been applied. Hospitalization is necessary for the modern treatment of fractures of the leg. Order *x*-ray examination before deciding upon the method of further treatment.

From "Fractures and Dislocations for Practitioners" by Edwin O. Geckeler (The Williams & Wilkins Company).

Original Articles

ESTABLISHED SURGICAL INFECTIONS

TREATMENT WITH UREA-SULFANILAMIDE MIXTURE

CHESTER W. BROWN, M.D.,
Resident Surgeon, Worcester City Hospital
WORCESTER, MASSACHUSETTS

LESLIE A. MCCLINTOCK, M.S.
Research Chemist, Worcester City Hospital
WORCESTER, MASSACHUSETTS

AND

EDWARD R. NEARY, M.D.
Medical Department, White Laboratories, Inc.
NEWARK, NEW JERSEY

THE topical use of sulfonamides alone in necrotic or purulent wounds is known to be of little or no therapeutic value. On the other hand, reports of experimental and clinical studies indicate that, in the local treatment of grossly infected wounds, urea-sulfonamide mixtures possess valuable antibacterial and related therapeutic properties.

Holder and MacKay[1] have investigated mixtures of urea (carbamide) and sulfonamides in wound therapy and have pointed out that urea enhances the antibiotic activity of sulfonamides (1) through a process of chemical débridement that rids the wound of necrotic tissue and cellular débris which give rise to sulfonamide-antagonists; (2) by solubilizing the sulfonamides, thus producing higher local concentrations of these drugs; (3) through hypertonic action and consequent local diapedesis, thus increasing the active cellular defense reaction within the wound.

Experiments by a group at the University of Minnesota demonstrated *in vitro* that urea inhibits the antisulfonamide action of methionine and para-aminobenzoic acid,[2] that in the presence of para-aminogenzoic acid the combination of sulfanilamide and urea possesses bacteriostatic activity in concentrations in which neither sulfanilamide nor urea alone shows antibacterial effect.[3]

One of us (L. A. Mc C.) has shown *in vitro* that the inactivation of sulfanilamide by concentrated solutions of protein and protein hydrolysate is prevented by urea, apparently through a deterrent effect of urea on the binding of sulfanilamide by protein or products of early protein hydrolysis.[4] Additional experimentation in the latter study also corroborated findings of other investigators, namely, that the antibacterial effect of sulfanilamide is potentiated and the antisulfonamide activity of para-aminobenzoic acid is inhibited by urea.

Although these and other published observations suggest the advantages of urea-sulfonamide mixture in local chemotherapy, the need for more careful clinical appraisal of combinations of urea and sulfonamide in topical treatment of accessible infections has not been adequately satisfied. Strakosch and Clark[5] have studied the comparative rate of healing in a small group of patients with bilaterally infected dermatoses, in which sulfathiazole was applied to one affected area and urea-sulfathiazole to the other in the same patient. These investigators observed a definitely shortened healing time in most of the urea-

sulfonamide treated lesions and also reported successful therapeutic results with urea-sulfathiazole in two cases of pyoderma caused by sulfonamide-fast Staphylococcus aureus. Ilfeld[6] has employed urea-sulfonamide mixtures in local chemotherapy of a small series of fresh contaminated wounds consisting of compound fractures and other severe trauma. He concluded that application of urea-sulfonamide mixture to fresh contaminated wounds, as a first aid measure, allows a long delay before definitive surgery and, as an adjuvant to formal surgery, permits primary closure and healing. Unfortunately, as indicated by the author, this investigation lacked a strictly comparable series of cases treated locally with sulfonamide alone and, consequently, any conclusions concerning the relative value of sulfonamide with and without urea are somewhat nullified.

PRESENT STUDY

Urea-Sulfanilamide Mixture. The purpose of the investigation to be described in this report was to evaluate urea-sulfanilamide mixture in the local treatment of established surgical infections, most of which were chronic in duration.

The urea-sulfanilamide, which was used for topical treatment of all cases, was a crystalline mixture consisting of three parts of urea and one part of sulfanilamide. This specific mixture was selected as most satisfactory on the basis of experimental and clinical observations indicating that the crystalline components in this ratio, when generously applied to a wound, supplied the maximal percentage of relatively insoluble sulfanilamide which would not give rise to foreign-body reaction, and an excess of freely soluble urea sufficient to assure its prolonged action *in situ*.

Our urea-sulfanilamide mixture was supplied in sealed, resilient, plastic tubes, within which the crystalline drugs had been sterilized by a non-toxic, chemical process that does not adversely affect either urea or sulfonamide crystals. Effective heat-sterilization of the mixture is not practicable, as pointed out by McClintock and Goodale,[7] since melting of the urea and decomposition of the mixture occur at sterilizing temperatures.

Other investigators of urea-sulfonamide dusting powders in the treatment of wound infections have presumably used unsterilized combinations of these drugs. However, the importance of effective sterilization of urea-sulfonamide mixtures is apparent in the Food and Drug Administration's finding that viable spore-forming anaerobes frequently contaminate unsterilized sulfonamide powders.[8] As emphasized by the authors of the foregoing report, possible presence of pathogenic anaerobes in sulfonamide dusting powders to be used in deep wounds constitutes an unnecessary hazard that can be eliminated by proper sterilization. This potential hazard of unsterilized sulfonamide dusting powders is equally applicable to unsterilized crystalline mixtures of urea and sulfanilamide.

The plastic tubes,* which served as containers for our urea-sulfonamide mixture, proved to be efficient insufflators for the crystalline mixture. They enabled the operator to make uniform applications of urea-sulfanilamide to the entire surface area of an infected wound. Moreover, because of their tubular shape and their size, the containers also were adapted to insertion into large sinus tracts and wound recesses and thus facilitated the insufflation of the chemotherapeutic mixture into infected sites that were otherwise inaccessible.

Clinical Material. Sixty hospitalized cases of serious—chiefly chronic—surgical infections have been studied. Representing most of the usual variety of such infections seen in general hospital practice, these consisted of hematogenous and post-traumatic osteomyelitis, purulent and necrotic

* The insufflator tubes of sterile urea-sulfanilamide, used in this study, were supplied by White Laboratories. Inc., Newark, N. J.

skin defects that required grafting, pulmonary abscess and thoracic empyema with external sinus tracts, and miscellaneous cases including infected postoperative wounds, trophic ulcers, etc.

In addition, several cases of suppurative peritonitis have been studied, particularly to determine the rate of absorption of sulfonamide from an infected serosal surface following the topical application of urea-sulfanilamide. In all cases in which the infected wound was external, the lesion was dressed once daily and the entire surface area of the wound freely covered with insufflated urea-sulfanilamide. This required daily application of 3 to 20 Gm. of the mixture per patient. In cases of draining lung abscess and empyema, 10 to 30 Gm. of urea-sulfanilamide per day were applied locally after insertion of the insufflating container into the short sinus tract. The more devious fistulous tracts were filled daily with the mixture by means of a soft rubber catheter attached to the insufflating container. Intraperitoneally, a single dose of 10 to 20 Gm. of urea-sulfanilamide was implanted at the time of operation.

Method of Study. Careful appraisal of a chemotherapeutic agent in surgical infections requires a plan of investigation that considers the many variable factors which may influence results, including among other determining elements the duration, previous treatment, extent of tissue destruction and bacterial population of such infections.

Meleney[9] has recently emphasized that the evaluation of drug therapy in established surgical infections is much more difficult than the appraisal of drug prophylaxis in contaminated wounds. In determining the prophylactic value of a drug in potentially infected or contaminated surgical wounds, control cases that are rigidly comparable with those in which the drug is to be used are both practicable and necessary. However, in appraisal of a drug in the treatment of established surgical infections, particularly of the chronic type in which markedly variable factors have been or are operative, strictly parallel controls are not available for comparison with drug-treated patients.

In the series of surgical infections which represent the clinical material of the study described in this report, the cases have been largely chronic. Comparable control cases could not be studied. Therefore, in attempting to evaluate local chemotherapy of such infections with urea-sulfanilamide, it has been necessary (1) to consider these infections, in their previous treatment, as their own controls and (2) to compare results of treatment by urea-sulfanilamide with those which we would expect on the basis of past surgical experience.

Bacteriologic Studies. Frequent studies of the qualitative and quantitative bacterial population of all wounds provided a means of confirming clinical response to treatment with urea-sulfanilamide. Wound cultures were made at the start of treatment and, insofar as possible, every three to five days during treatment with the mixture. Specially prepared swabs, which absorbed approximately 0.1 cc. of fluid, were used to obtain samples of wound exudates. From saline suspensions of these, aerobic and anaerobic cultures and colony counts were made on meat infusion agar with dextrose and on solid thioglycollate agar, respectively. Cultures on blood agar and in tryptose phosphate broth were also routine. In addition, estimation *in vitro* of the antibacterial threshold concentrations of sulfanilamide for organisms isolated from certain wounds at the start of treatment helped to establish the degree of sulfonamide-resistance that these bacterial invaders manifested in failing to respond to earlier treatment with sulfonamide alone.

Periodic hemopoietic, blood chemistry and other pertinent laboratory studies were made in all cases. Clinical progress was charted and recorded in the usual way.

Results of treatment with urea-sulfanilamide have been classified, following the

recommendation of Meleny,[9] from the standpoint of the effect of the drug mixture on the infectious process:

"Excellent," when the result was promptly and surprisingly favorable
"Good," when the beneficial result was definite but not particularly unusual
"Questionable," when the beneficial result was probably brought about by factors other than the drug mixture, too delayed to be significant, or in general doubtful
"No effect," when the result was definitely unfavorable and the progress of the infection remained unchanged in spite of treatment with the drug mixture

RESULTS

Case history data and results of treatment with urea-sulfanilamide are compiled in Table I. In this tabulation cases have been grouped, to facilitate general discussion, under the headings: "Osteomyelitis," "Infected Skin Grafting Sites," "Thoracic Surgical Infections" and "Miscellaneous Surgical Infections." A summary of results in each of these groups of cases is contained in Table II.

COMMENTS ON RESULTS

We hesitate to draw any conclusions from our observations concerning the value of urea-sulfanilamide mixture in chronic hematogenous osteomyelitis. Since this disease is characterized by spontaneous remissions of many years, a method of chemotherapy cannot be easily evaluated. Suffice it to say, therefore, that in our cases of hematogenous osteomyelitis the local slough was promptly disposed of by urea-sulfanilamide and subsequent healing was somewhat shortened. In our cases of traumatic osteomyelitis we usually observed a gratifyingly favorable response, that could more definitely be ascribed to local treatment with urea-sulfanilamide.

The group of cases in which, on the whole, we noted most impressive results was that consisting of grossly infected skin defects that were being prepared for grafting. In such cases, it is frequently of the utmost importance to shorten the time of preparation. Third degree burns over flexor surfaces or in other areas where contractures would be disabling or disfiguring should be grafted as early as possible. It is well recognized, too, that for a thick graft the recipient site should be as sterile as practicable. We have used a graft of $^{22}/_{1000}$ inch (estimated $^{2}/_{3}$ full thickness) on a deep facial burn prepared with urea-sulfanilamide (Case 8) with primary healing and a 100 per cent "take." It has been possible by treatment of severely infected skin defects with urea-sulfanilamide to cause the bacterial count of the wound culture to decrease from 100,000 and more per cc. to "no viable organisms," in some instances within eight to ten days. Such potential sterilization of the recipient site, together with the extremely vascular granulation observed to result from local treatment with urea-sulfanilamide, produces an ideal bed for a graft. (Figs. 1 and 2.)

In our series of ten patients with grossly infected skin defects that were prepared for grafting with locally applied urea-sulfanilamide, fifteen split-thickness grafts were used. There was a 98 to 100 per cent "take" in twelve of the grafts, and an 88 to 90 per cent "take" in the remaining three grafts. Although we have not studied the comparative efficacy of topically applied urea-sulfanilamide and of penicillin in the preparation for grafting of frankly infected skin defects, it is interesting to note that the results we have observed with urea-sulfanilamide seem equally as good as those described by Hirshfeld and associates[10] in their report of the value of parenterally administered penicillin in the pre-grafting management of similar lesions. These investigators noted a 90 to 100 per cent "take" in eighteen and an 80 per cent "take" in only one of a total of nineteen split-thickness grafts,

following preliminary intramuscular administration of penicillin.

In our cases of externally draining lung abscess and empyema, the thick, foul, purulent exudate rapidly became serous under treatment with urea-sulfanilamide and, in all cases save one (Case 21), the wounds filled completely from below with clean granulation. Sinus tracts were kept open until healed by daily dressing, insufflation of the powder into the depths of the tracts, and loose packing with dry gauze.

In many of our group of cases classified as "Miscellaneous Surgical Infections," accurate evaluation of urea-sulfanilamide has been difficult. However, on the basis of past experience and because many of these cases had not responded favorably to any other method of treatment—including in some instances systemic and local chemotherapy with sulfonamides—we arrived at what seemed a conservative and reasonably correct appraisal of urea-sulfanilamide in each case of this group, as noted in Table 1.

A B

Fig. 1. A, F. O., a student nurse, fainted while ironing. The hot electric iron fell on the left side of her face producing a deep burn 6 by 9 cm. in area, in which there was complete destruction of tissue down to the facial muscles. After nineteen days of local treatment with wet dressings and following débridement the wound still showed considerable slough and abundant growth of Staphylococcus aureus and Streptococcus hemolyticus. Local treatment with urea-sulfanilamide was then begun and the photo above was taken several days later. B, the excellent end result obtained with grafting is illustrated. A split graft, $^{22}/_{1000}$ inch in thickness, was used twelve days after start of local applications of urea-sulfanilamide with a 100 per cent "take" and primary healing. The success of a free graft of this thickness is considered most unusual and can be ascribed largely to the virtual sterility of the wound at the time of grafting. No organisms could be cultured from the wound after one week of topical treatment with urea-sulfanilamide.

Local Use of Urea-Sulfanilamide in Suppurative Peritonitis. When a sulfonamide powder is implanted into a grossly infected peritoneal cavity, its antibacterial effect is undoubtedly largely inhibited by sulfonamide-antagonists in the purulent exudate which cannot be completely evacuated. However, it seemed that urea-sulfanilamide might be used advantageously in the local management of suppurative peritonitis, since the urea could reasonably be expected to counteract sulfonamide-antagonists present in the residual peritoneal pus. Because of this protective

effect of urea on sulfanilamide, it was logical to assume that, if urea-sulfanilamide was to be used intraperitoneally, less intensive efforts might properly be made at operation to remove *all* peritoneal pus, and the abdominal viscera, thus, would be spared much undesired but otherwise necessary manipulation.

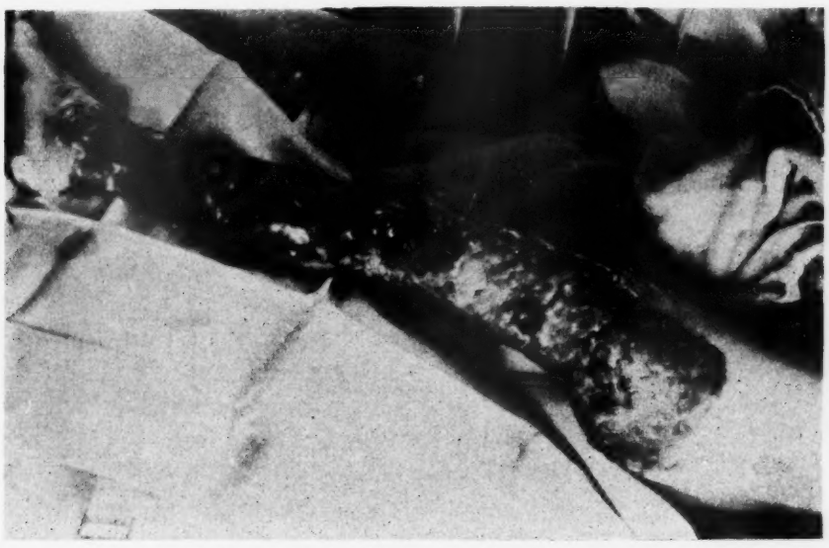


Fig. 2. A, E. I., aged six, sustained an extensive third degree burn of his left leg and thigh. After two weeks' local treatment with 1 per cent sulfanilamide solution, the wound still contained considerable slough and discharged a moderate amount of foul exudate. Wound cultures demonstrated pure growth of Staphylococcus aureus. The photo above was taken at this time and topical treatment with urea-sulfanilamide was begun.

Urea-sulfanilamide implanted into the *normal* peritoneal cavity of rabbits has been demonstrated to be grossly and histologically innocuous but in the same study[11] it was also observed that the solubilizing effect of urea on sulfanilamide caused the latter to be absorbed so rapidly from the animal's normal serosal surface that a high concentration of sulfanilamide *in situ* could at best be only transient.

Nevertheless, in several cases of suppurative peritonitis, one (Case 60) of which is listed in Table I, we endeavored to evaluate the clinical use of intraperitoneally implanted urea-sulfanilamide and simultaneously to determine the rate at which the sulfonamide component of the mixture is absorbed from the grossly infected peritoneum. At operation, 10 to 20 Gm. of urea-sulfanilamide (representing 2.5 to 5 Gm. of sulfanilamide) were insufflated into the peritoneal cavity of each patient. Blood levels of free sulfonamide were determined at intervals throughout forty-eight hours following the intraperitoneal application of the mixture. The maximal and minimal rates of sulfonamide absorption observed in our cases are shown in Table III.

The rate of sulfonamide absorption following topical application of urea-sulfanilamide mixture in suppurative peritonitis is apparently sufficiently prolonged to allow the mixture to exert a definite local chemotherapeutic effect. The highly satisfactory postoperative course observed in each case of peritonitis in which urea-sulfanilamide was used intraperitoneally can be attributed in good measure, we believe, to the local efficacy of the drug mixture.

SULFONAMIDE-RESISTANT CASES

Of those infections which were clinically regarded as sulfonamide-resistant,—on the basis of lack of response to previous local or systemic therapy with sulfonamides,—

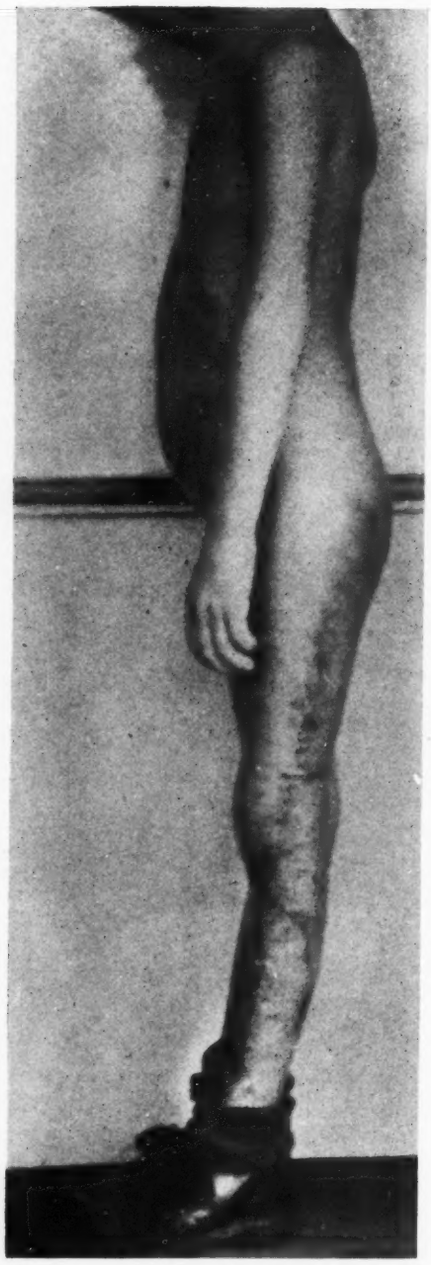


FIG. 2. B, two weeks after start of local treatment with urea-sulfanilamide the wound was devoid of slough and had healthy granulations throughout its area. The bacterial count had markedly decreased and the large skin defect was split-grafted in three stages with a 98 per cent "take." There was no contracture. The photo above was taken about one month after grafting.

four cases* were selected for *in vitro* study of predominant pathogens isolated from the wounds. The object of such study was to demonstrate whether the apparent sulfonamide-resistance of these bacteria *in vivo* could be duplicated *in vitro* and whether the cultured organisms would be found to be readily susceptible to urea-sulfanilamide.

Each of the four isolated organisms* was shown to grow without demonstrable inhibition in the presence of concentrations of sulfanilamide that far exceeded the concentrations which caused complete growth-inhibition of known sulfonamide-susceptible bacteria. The degree of *in vitro* sulfonamide-resistance varied among the four pathogens, Staphylococcus aureus (Case 19) proving most and pneumococcus (Case 20) least resistant. A sulfanilamide concentration of 200 mg. per cent failed to inhibit completely the growth of these organisms, except in the case of pneumococcus which was completely inhibited by a drug concentration of 170 mg. per cent. However, in the presence of amounts of urea sufficient to produce only very slight growth-inhibition, concentrations of sulfanilamide ranging from 10 to 30 mg. per cent caused complete growth suppression of all four organisms.

It was concluded, therefore, that these bacteria possessed varying degrees of sulfonamide-resistance which could be counteracted, through some unexplained mechanism, by adequate local concentrations of urea. That the bacterial strains represented by these organisms were susceptible *in vivo* to urea-sulfanilamide was apparent in the progressive decline of the wound flora and the gratifying chemotherapeutic results in the cases from which the organisms had been isolated, as noted in Table 1.

* Cases 3, 5, 19 and 20 from which the following predominant pathogens were respectively isolated: Clostridium welchii, anaerobic streptococcus, Staphylococcus aureus, pneumococcus (Type XXIII).

COMMENT

As urea-sulfanilamide comes in contact with a purulent exudate, it rapidly goes into solution. As long as the wound discharge is profuse, a dry sterile dressing is best used after insufflation of the mixture into the wound. Local edema rapidly subsides and the amount of wound exudate greatly decreases within a few days. At this point it has been found advisable to employ dressings soaked in saline instead of dry gauze dressings. Saline dressings prevent dryness and crusting of the non-discharging wound and do not impede local absorption of the mixture.

As wound edema subsides, it seems that early vascularization occurs and granulation progresses more rapidly than usual. When healthy granulations have appeared and wound discharge is scant, much smaller amounts of insufflated urea-sulfanilamide suffice and do not retard epithelization as larger quantities of the mixture are likely to do at this stage of treatment. In the pre-grafting preparation of infected skin defects, however, generous quantities of urea-sulfanilamide may be topically applied up to the time of grafting.

In none of the cases studied, have we observed any reaction that could be construed as a manifestation of local or systemic toxicity to urea-sulfanilamide. No significantly abnormal findings, attributable to the use of the mixture, have been demonstrated in frequent hematologic and urinary studies throughout treatment.

SUMMARY

1. Evaluation of local treatment with a sterile urea-sulfanilamide mixture has been attempted in sixty cases of established surgical infections, most of which were chronic.

2. Plastic insufflator tubes, in which the sterile drug mixture was supplied, permitted uniform distribution of the mixture to surface wounds and facilitated its application into large sinus tracts and wound recesses.

3. Therapeutic response was impressive in the majority of cases, including infections that had previously failed to respond to treatment with sulfonamides alone. Clinical improvement was corroborated by progressive, sometimes rapid, decrease in bacterial populations of the wounds.

4. In suppurative peritonitis urea-sulfanilamide, intraperitoneally applied at operation, was absorbed at a rate sufficiently slow to allow the mixture to exert a local chemotherapeutic effect.

5. Four cases in which the infecting organisms appeared to be sulfonamide-resistant responded favorably to treatment with urea-sulfanilamide. Predominant pathogens, isolated from the wounds in these cases, showed varying degrees of sulfonamide-resistance *in vitro* but were completely inhibited by urea-sulfanilamide in concentrations at which each drug alone was ineffectual.

6. No evidence of local or systemic toxicity to topically applied urea-sulfanilamide was observed in any of the cases studied.

7. Sterile urea-sulfanilamide has been found to be an efficacious local chemotherapeutic agent for septic wounds. Its rapid removal of slough from necrotic lesions and its non-toxic, antibacterial activity even in the presence of much purulent exudate and devitalized tissue are advantages well worth emphasizing.

The authors gratefully acknowledge the cooperation of the Clinical and Laboratory Staffs of Worcester City Hospital, Worcester, Mass., in carrying on this study.

REFERENCES

1. HOLDER, H. G. and MACKAY, E. M. Wound therapy. *Mil. Surg.*, 90: 509, 1942; Carbamide-sulfonamide mixtures in wound therapy. *Surgery*, 13, 677, 1943.

2. TSUCHIYA, H. M., TENENBERG, D. J., CLARK, W. G. and STRAKOSCH, E. A. Antagonism of antisulfonamide effect of methionine and enhancement of bacteriostatic action of sulfonamide by urea. *Proc. Soc. Exper. Biol. & Med.*, 50: 262, 1942.

3. Ibid. In vitro effect of urea-sulfathiazole combination of sulfathiazole-resistant staphylococci. *Proc. Soc. Exper. Med. & Biol.*, 51: 245, 1942.
4. McClintock, L. A. and Goodale, R. H. Studies on the improvement of wound therapy by the use of synergistic mixtures of antibacterial substances. *U. S. Naval Bull.*, 41: 1057, 1943.
5. Strakosch, E. A. and Clark, W. G. Beneficial effect of urea in topical sulfonamide therapy. *Minnesota Med.*, 26: 276, 1943.
6. Ilfeld, F. W. Carbamide sulfonamide mixtures. *Surg., Gynec. & Obst.*, 76: 427, 1943.
7. Meleney, F. L. Difficulty of evaluating drug treatment in surgical infections. *J. A. M. A.*, 124: 1021, 1944.
8. McClintock, L. A. and Goodale, R. H. A sterilization process for powdered sulfonamides. *U. S. Naval Bull.*, 41: 1365, 1943.
9. Welch, H., Slocum, G. G. and Herwick, R. P. Tetanus from sulfonamide dusting powders. *J. A. M. A.*, 120: 361, 1942.
10. Hirshfeld, J. W. et al. Penicillin and skin grafting. *J. A. M. A.*, 125: 1017, 1944.
11. Belding, D. L. et al. Personal communication.

It is only by the early use of skin grafting that contractures can be prevented in extensive total skin-loss burn cases.

From "Surgery of Modern Warfare" edited by Hamilton Bailey (The Williams & Wilkins Company).

LIGATION OF A SUPERNUMERARY URETER*

CLINICAL AND EXPERIMENTAL STUDY

ALBERT E. GOLDSTEIN, M.D. AND BEN KLOTZ, M.D.
Chief of Genito-Urinary Department, Sinai Hospital
Now a Lieut. Comdr. in the United States Naval Reserve
BALTIMORE, MARYLAND

INTENTIONAL ligation of an ureter without performing a nephrectomy is rarely ever performed excepting in experimental work. Intentional ligation of a supernumerary ureter without performing a heminephrectomy is the subject of discussion in this paper.

Experimentally, Francesco De Victorius-Medori[1] recently reported on early atrophy of the kidney without hydronephrosis following ligation of the ureter. It is interesting to note but not explained in his report of thirty-five experiments why only two terminated in atrophy while the others showed hydronephrosis.

Reference in this same article is made to many other investigators such as Bachrach, Frank and Glass who claim that early atrophy of the kidney results in every case of ligation of the ureter, whereas others like Delbert and Pepper claim that atrophy does occur frequently. It is further stated in the article that Scott, Albarran, Boemingham and others always obtain primary hydronephrosis and not atrophy after ligation of the ureter in animals.

Inasmuch as we were interested in what happens to a human kidney after a supernumerary ureter is intentionally ligated, we carried out some animal experiments for comparative studies.

It has been our experience in our experimental work on dogs, that hydronephrosis results first from ligation of the ureter and that atrophy must be secondary since none of our cases demonstrated an early atrophy.

It is a well recognized fact that the supernumerary fused kidney frequently suffers pathological changes. We have encountered many cases of supernumerary fused kidneys with two ureters and have reported on seven bilateral cases.[2] We have always found that in the supernumerary fused kidney the upper segment was the least developed and when pathological changes did occur they occurred principally in this segment. In a number of instances we have seen the pathological condition in the lower segment as well.

We became interested in patients who had pain and discomfort thought to be renal in origin but were found to have non-pathological supernumerary fused kidneys and in whom there was no improvement from any type of treatment.

In the past eight years, we selected three such patients for study, two of whom had unilateral and one bilateral supernumerary fused kidneys. After a careful study we concluded that since there was insufficient reason for performing a heminephrectomy in a non-pathological uninfected supernumerary fused kidney that we would perform a ligation of the supernumerary ureter which is a less hazardous procedure, in an effort to relieve the patients of their discomfort.

By doing this we hoped that ultimately atrophy would result in the supernumerary segment and, if the discomfort was caused by the supernumerary kidney, that relief would be obtained. The work was purely experimental and of scientific interest to us and was fully explained to the patients.

Four clinical cases plus our experimental work forms the basis of our report and we

* From the Department of Genito-Urinary Surgery, Sinai Hospital, and Experimental Operative Surgery of the University of Maryland.

present it for consideration. A brief review of the cases is as follows:

CASE REPORTS

Case 1. V. D. E., twenty-one, a female, single, stenographer, was first seen on June 18, 1936. Her complaint was pain in the left lumbar region which she had experienced intermittently for about nine months. For the last two months the pain had been constant. During some of her attacks, she had had chills and fever causing her to remain in bed. She had urinary frequency also during these attacks. Her family, past, and menstrual history were unimportant.

In the examination, the left kidney was definitely palpable, with tenderness in the left flank. Her urine was uninfected. The positive findings on cystoscopy and pyelography revealed a left supernumerary fused kidney, two left ureters and two left ureteral orifices. The upper pelvis and calyces were the least developed of the two. The capacity of the left upper pelvis was 5 cc, while that of the lower was 10 cc. (Fig. 1.)

The phenosulphonphthalein test showed 10 per cent from the left upper segment, 10 per cent from the left lower segment and 12.5 per cent from the right kidney.

The diagnosis was complete reduplication of the urinary tract on the left, with a fused supernumerary kidney, supernumerary ureter, and ureteral orifice.

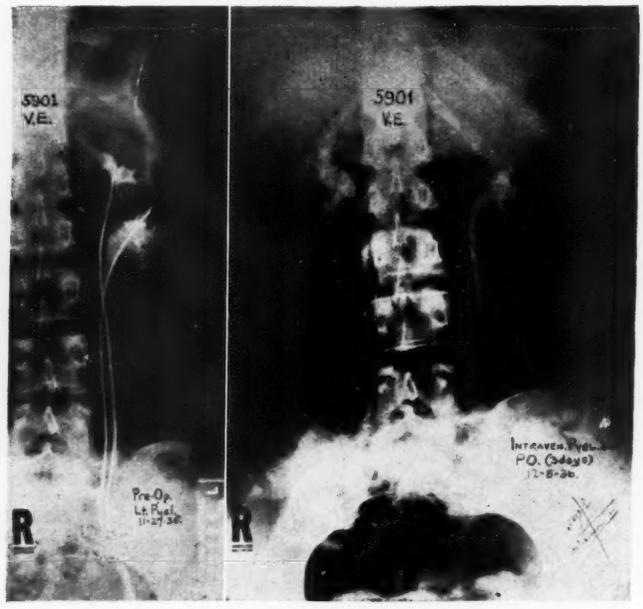


Fig. 1. Fig. 2.

Fig. 1. Case 1. V. D. E. Left supernumerary fused kidney; left retrograde pyelogram November 27, 1936.

Fig. 2. Case 1. V. D. E. Intravenous pyelogram December 17, 1936, twenty days after ligation of left ureter leading to upper segment; no dye in upper segment.

After several dilatations of the left ureters, the patient obtained no improvement, so ligation of the supernumerary ureter was suggested. Six months later the supernumerary ureter was ligated in its mid-portion. Forty-eight hours after the operation the patient claimed she felt better and did not have any pain. During her stay in the hospital she was relieved of all her pain. She remained free from this symptom until she started working, when she developed some pain which she described as being different in character. This finally disappeared.

During her stay in the hospital intravenous pyelograms were made twenty days after the operation. (Fig. 2.) These showed bilateral normal pelves and calyces with no solution in the supernumerary kidney or ureter. On June 2, 1938, a relative phenosulphonphthalein test was made, and this showed 12.5 per cent from the right kidney and 18 per cent from the left

kidney in fifteen minutes. When last heard from (May 15, 1944) which was seven years after her operation she claimed she was free from pain and is now attending a nursing school.

Case II. C. K., thirty-eight years of age, married, a female housewife, was first seen August 14, 1934. Her complaint was pain in the left lower abdominal quadrant. She had this pain off and on for five years. In addition to the pain in the lower quadrant she had pain in the upper quadrant. It was of an intermittent type, sometimes being sharp, other times dull. Associated with the pain was urinary frequency, pain on voiding, some suprapubic discomfort, some nausea, but no chills or fever. Her past history was of importance in that she had an ovary removed for pain in her left abdomen and her appendix removed for pain in the right abdomen. She was nervous most of the time.

In the examination, both kidneys were palpable and appeared enlarged on the plain roentgenogram. She was tender in both the upper and lower left quadrant, with some tenderness in the left flank. Her urine was uninfected. On cystoscopy the positive findings were two ureteral orifices on each side. Catheters passed up all four ureters but encountered a definite obstruction in the ureter leading to the upper pelvis on each side. This was overcome. Urine from each kidney was uninfected.

Fig. 3. Case II. C. K. Bilateral retrograde pyelogram August 14, 1934.

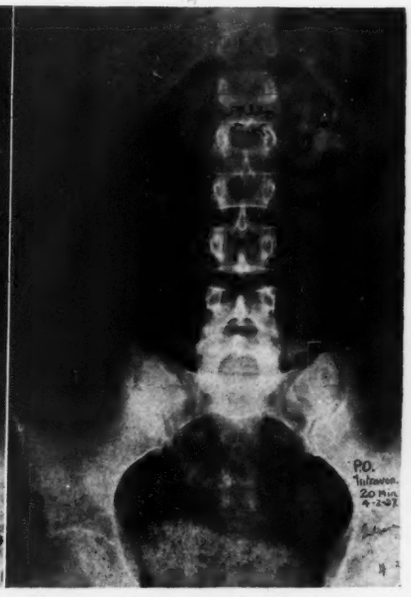


Fig. 4. Case II. C. K. Intravenous pyelogram April 2, 1937. Ligation of supernumerary ureter, right, March 19, 1937; no dye in upper right segment.

The capacities of the kidneys were: Right upper segment 3 cc.; right lower segment 9 cc.; left upper segment 3 cc.; left lower segment 10 cc.

The phenolsulphonphthalein test revealed: The right upper segment, first fifteen minutes 8 per cent—right lower segment 6 per cent; the left upper segment, first fifteen minutes 7 per cent—left lower segment 7.5 per cent.

Bilateral retrograde pyelograms revealed that the upper pelvis of each segment was small and of the rudimentary type, whereas the lower pelvis and calyces of each segment were of normal size and well formed. Both double kidneys were of the fused type. (Fig. 3.)

The diagnosis was bilateral supernumerary fused kidneys with complete reduplication of the ureters and ureteral orifices.

Ureteral dilatations were given on numerous occasions with temporary relief. She began developing similar pains in her right side. During one of her severe attacks she was taken to the hospital.

On March 19, 1937, about thirty months after the original examination, a ligation of the right supernumerary ureter was performed. Almost immediately she was relieved of pain which did not return. Fourteen days after the operation, an intravenous pyelogram was made

which showed no dye in the upper pelvis of the right kidney. The lower pelvis and calyces on the right were normal. There were no changes in the pyelograms of the left double kidney. (Fig. 4.)

Fig. 5. Case III. C. K. Left retrograde pyelogram June 15, 1937.

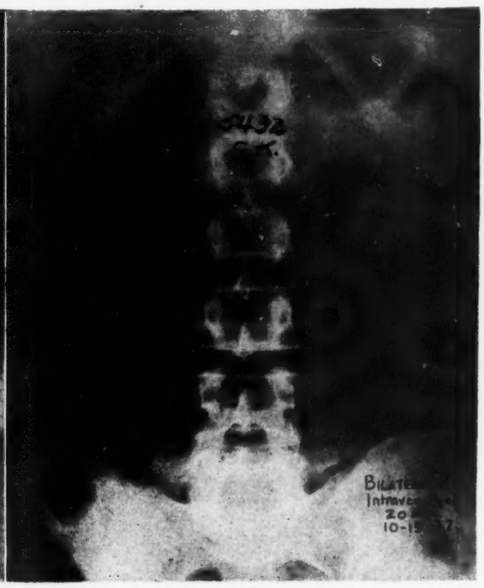


Fig. 6. Case III. C. K. Left ureteral ligation October 5, 1937; intravenous pyelogram October 15, 1937; no dye in either upper segment.

A postoperative relative phenosulphonphthalein test showed 10 per cent of phthalein in fifteen minutes from the remaining right kidney against 17.5 per cent from both left kidneys.

Case III. C. K., forty-one years old, married, a female housewife, was the same patient as in Case II. While her first complaint was pain on the left side, her first operation was on the right kidney. For the past seven months her pain on the left became worse and since she had obtained so much relief from the operation on the right kidney, she finally insisted upon an operation on the left kidney. The pyelograms of the left were the same as on previous occasions. (Fig. 5.)

The relative phenosulphonphthalein test showed 18 per cent from the right kidney, 7.5 per cent from the lower left segment and 7 per cent from the upper left segment.

On October 5, 1937, a ligation of the supernumerary left ureter was performed, the same as was done on the right.

Three days after the operation her pain ceased and she has not had any since. Ten days after the operation, an intravenous pyelogram was made and this showed no dye in either supernumerary portion of the kidney. (Fig. 6.) The lower pelves and calyces were normal in size and shape. Seventeen days after the operation she was discharged from the hospital. Eight months after the last operation a relative phenosulphonphthalein test was given and this showed 17 per cent from the right kidney and 15 per cent from the left kidney. She was free from pain and felt better than she had in eight years.

The last time she was seen was, March 4, 1944; which was seven years after the first ligation and six and one-half years after the second ligation. She claimed that she was free from pain.

Case IV. L. W., forty years of age, a female married housewife, was first seen February 15, 1937. The complaint was pain in the left side and back. Her family, past, and menstrual history were unimportant. For a year she has had a dull ache in the left flank, radiating sometimes to the left lower quadrant. This pain was intermittent and was worse on standing. During this time she had had urinary frequency, and suprapubic discomfort, but no nausea, chills or fever. She was a rather nervous type of individual.

In the examination, the left kidney was palpable. There was tenderness in the left lumbar region and some tenderness also in upper left abdominal region. Her urine was uninfected. A plain roentgenogram showed a long, high left kidney.

On cystoscopy, two ureteral orifices were found on the left. The ureteral orifice leading to the upper left segment was pin-point in size and very difficult to enter. After many attempts a small catheter passed up this ureter. Urine from both left segments was free from infection. The capacity of the upper left segment was 5 cc. The capacity of the lower left segment was 8 cc.

The phenosulphonphthalein test showed 7 per cent from the upper left segment in fifteen minutes, 11 per cent from the lower left segment and 17 per cent from the right kidney in the same length of time.

Left retrograde pyelograms revealed a fused supernumerary kidney with supernumerary ureters and ureteral orifices. The supernumerary portion (upper) was not well developed. (Fig. 7.)

The diagnosis was fused supernumerary left kidney with supernumerary left ureter and ureteral orifice.

On March 18, 1938, a ligation of the left supernumerary ureter was performed. The patient was relieved of pain in three days. Twenty-one days after operation, an intravenous pyelogram was made and this showed no dye in the supernumerary portion (upper) of left kidney. There was some dye in the lower left kidney and in the right kidney. (Fig. 8.)

A postoperative (two months) phenosulphonphthalein test showed 19 per cent from the right kidney in fifteen minutes and 20 per cent from the left kidney in the same length of time.

Since the operation, she has had a slight discomfort in the left lumbar region but she claimed it was a different type of discomfort. When last seen on April 6, 1944, which was six years after the ligation, she claimed that she was free from pain.

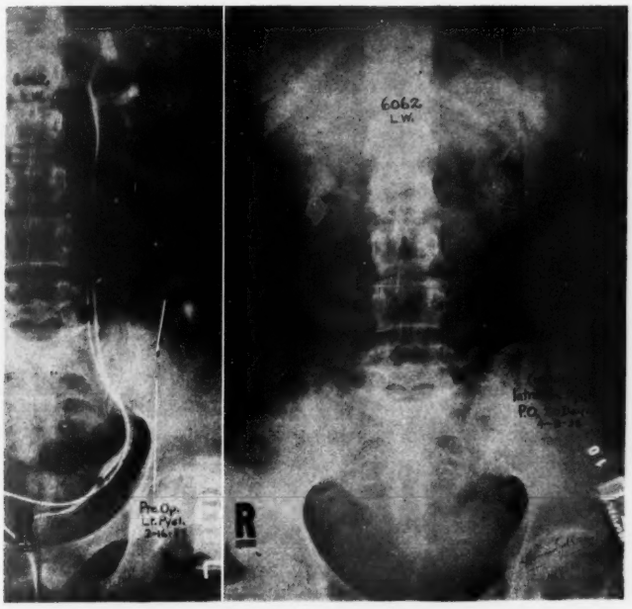


Fig. 7. Fig. 8.

Fig. 7. Case iv. L. W. Left retrograde pyelogram.

Fig. 8. Case iv. L. W. Ligation of upper left segment March 18, 1938; intravenous pyelogram April 8, 1938; no dye in upper left segment.

CLINICAL MATERIAL

The clinical application of ligation of a supernumerary ureter was used by us in four cases on three private patients, one patient having the operation performed bilaterally because of pain in bilateral supernumerary fused kidneys. The operation in all the cases was performed because of pain either in the lumbar or abdominal region. In three cases the discomfort and pain was on the left side, whereas in one, it was bilateral. The pain had been present between six months and seven years. It was intermittent at first but later became constant in all the cases and although not sharp, was very acute in two cases, simulat-

ing either a kidney colic or Dietl's crisis. Activity seemed to increase the pain. None of the patients showed any evidence of infection either by the presence of pus or organisms. All the patients were females under forty years of age, one having borne children whereas, the other two had not. Two of the three patients were married.

Functional studies revealed a good output in the opposite kidney, as well as a good excretion in the lower normal segment. The function of the supernumerary or upper segment was found to be fair. The capacities of the pelves of the upper segments were less than the lower ones, ranging between 3 and 5 cc.

The pyelographic studies were made both by the intravenous and retrograde method, and it was observed in all the cases that the pelves and the calyces of the upper segments were smaller than the pelves and calyces of the lower ones. A reproduction of the pain was obtained in all the cases by injecting the supernumerary segment with water.

Numerous dilatations, first of the supernumerary ureter, and then of the other ureter on the same side was performed in all the cases. The number of dilatations of the supernumerary ureter varied from three to twelve. In one case the supernumerary ureter presented a real stricture at the orifice. In the other cases a No. 6 catheter met a slight obstruction which was easily overcome. None of the cases showed a dilatation of the supernumerary ureter.

The emptying time seemed to be normal (four to eight minutes) in all the supernumerary segments.

All the patients seemed to be of a nervous type. Gynecological, orthopedic, and psychiatric examinations were made on all patients. In only one case was there a question of a psychiatric problem.

EXPERIMENTAL MATERIAL

In an effort to observe what happens to the kidney after the ureter is ligated one ureter of each of eight dogs was ligated and cut. While we were unable to ligate supernumerary ureters in the dog, we were able to study the condition of the kidney after one ureter was ligated. As near as possible the studies were made along the lines similar to those made on the human. These studies included the notation of the size of the preoperative and postoperative kidney. The functional studies of the kidneys were made after the complete ligation of the ureter by studying the urinary output of the kidney and by studying the kidney pelves and calyces after intravenous pyelography. In reality this latter method is a functional study because it is dependent upon the work of the excretory apparatus of the kidney. Retrograde pyelography was also performed so that comparisons could be made with those of intravenous pyelography as well as to determine whether hydronephrosis takes place with or without atrophy of the kidney and when it occurs.

These studies were made at various intervals ranging from one hour to thirteen days after ligation of the ureter.

OPERATIVE TECHNIC IN CLINICAL CASES

Previous to the operation a catheter was placed in the supernumerary ureter. The ureter was exposed extraperitoneally through a Gibson incision. The mid-third of the ureter was selected for the ligation. After the ureter had been freed for a short distance, three chromic catgut ties were placed around the ureter about ½ cm. apart. The ureter was cut so that two of the ties were left on the lower portion and one on the upper portion of the ureter. A small portion of the ureter was removed for examination. The upper portion of the ureter was observed for a few moments but no great perceptible dilatation of the ureter occurred. No leakage of urine resulted from the operation so that the wound was closed without drainage. The operating time varied between twenty-five and thirty-five minutes. Avertin anesthesia was used in the four operations.

OPERATIVE TECHNIC IN EXPERIMENTAL WORK

Since the dogs did not have supernumerary ureters, it was not necessary to place catheters into the ureters. The dogs weighed between 12 and 20 pounds and were between one and three years of age. Soap and water and iodine technic was used. The right kidney and ureter was selected for the experimental work. The kidney and ureter was exposed through a transperitoneal operation in all of the cases. In most of the cases the post peritoneum was opened to expose the kidney and ureter. Two catgut ties were made in the mid-third of the ureter and was cut between them. No leakage of urine resulted. The post peritoneum when opened was not closed in any of the cases. The peritoneum, muscles, fascia and skin were separately sutured with continuous plain catgut. The upper portion of the ureter was sutured underneath the skin so that further studies could be made. No drainage was established in any of the cases. Collodion dressings were applied.

From 3 to 4 cc. of nembutal were injected intravenously before the operation, and ether was used during the operation.

Eight dogs were operated upon fourteen times for the experiments.

Fig. 9. Dog 7. Intravenous pyelogram one hour after right ureteral ligation; no dye on right.

Fig. 10. Dog 8. Intravenous pyelogram one day after right ureteral ligation; no dye on right.

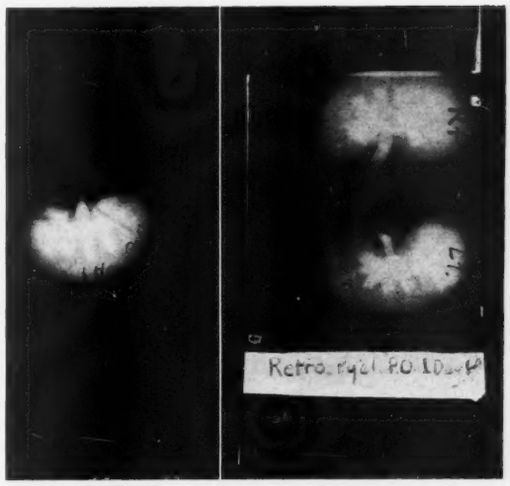


Fig. 11. Fig. 12.

Fig. 11. Dog. 7. One hour postoperatively; retrograde pyelogram of removed kidney whose ureter was ligated; slight dilatation of pelvis and calyces.

Fig. 12. Dog. 8. One day postoperatively; retrograde pyelogram of both kidneys; right side, ureter ligated; left side, not ligated; more dilatation in right kidney than left kidney.

PREOPERATIVE AND POSTOPERATIVE STUDIES IN CLINICAL CASES

Both preoperatively and postoperatively the urine was free from pus and organisms. The urine functioned at the same rate postoperatively from the remaining kidney as it did preoperatively.

The phenosulphonphthalein tests revealed the following per cents in fifteen minutes.

	Preoperative	Postoperative
Case I—Rt. kidney	12.5	12.5
Lt. lower segment	10	18
(Sup.*) Lt. upper segment	10	None, operative side
Case II—Rt. lower segment	6	14
(Sup.) Rt. upper segment	8	None, operative side
combined Lt. kidney	14.5	16
Case III—Rt. kidney	18	17
Lt. lower segment	7.5	15
(Sup.) Lt. upper segment	7	None, operative side
Case IV—Rt. kidney	17	19
Lt. lower segment	7	20
(Sup.) Lt. upper segment	11	None, operative side

* Supernumerary.

The studies of the capacities (in cc.) of the kidneys were as follows:

	Preoperative	Postoperative
Case I—Rt. kidney	10	10
Lt. lower segment	10	10
(Sup.*) Lt. upper segment	5	None, operative side
Case II—Rt. lower segment	9	9
(Sup.) Rt. upper segment	3	None, operative side
Lt. lower segment	10	10
(Sup.) Lt. upper segment	3	3
Case III—Rt. kidney	9	9
Lt. lower segment	10	10
(Sup.) Lt. upper segment	3	None, operative side
Case IV—Rt. kidney	8	8
Lt. lower segment	8	9
(Sup.) Lt. upper segment	5	None, operative side

* Supernumerary.

The pyelographic studies in the clinical cases were made by the retrograde method preoperatively and the intravenous method postoperatively. The purpose of the intravenous method postoperatively was to study if possible the function and to visualize the kidney whose ureter was ligated. We were also able to visualize and study the pelvis of the other portion of the double kidney and to visualize the kidney on the opposite side.

In these studies we always found the upper segment to have the smaller pelvis, varying from 3 to 5 cc. in capacity, while the other pelvis was the larger, varying from 7 to 10 cc.

The postoperative studies demonstrated that no solution appeared at any time in the kidney whose ureter was ligated, while the other pelves and calyces on both sides demonstrated its appearance in five to fifteen minutes, showing no dilatation following the operation. The kidney of the ligated ureter was studied as early as three days and as late as sixty days postoperatively.

PREOPERATIVE AND POSTOPERATIVE STUDIES IN THE DOGS

The preoperative studies on the dogs were simply to note the condition of the kidney and ureter as to infection and size. None of the dogs had any infection either before or after the ligation. The kidneys were measured before and after the ureter was ligated. The change in the size of the kidney depended upon the length of time that had elapsed after the ligation of the ureter. The kidneys and ureters were studied, one hour, twenty-four hours, three, six, ten, and thirteen days after the ligation. The kidney increased in size in all dimensions, the longer the time elapsed after the ligation of the ureter. This increase varied from ½ to 2 cm. in length in the dog's kidney, three days after the ligation and continued on to increase in size up to thirteen days after ligation of the ureter. This was the longest time that the dogs' kidneys were studied in these

experiments. The kidney of the dog, one and twenty-four hours after ligation showed no increase in size.

Fig. 13. Dogs 5 and 6. Three and six days postoperatively showing definite dilatation of the pelves and calyces, more in the dog of sixth postoperative day (6) than in the dog of third postoperative day (5).

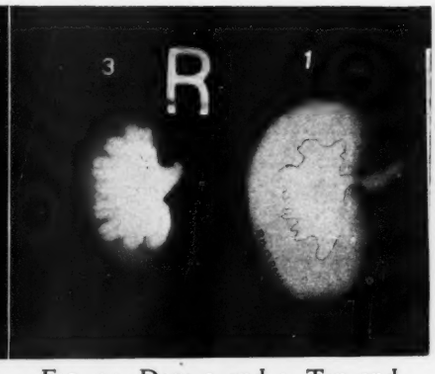


Fig. 14. Dogs 3 and 1. Ten and thirteen days postoperatively; retrograde pyelogram showing definite dilatation of the pelves and calyces, less in the ten day postoperative dog (3) than in the thirteen day postoperative dog (1).

After the ligation of the ureter, the pelvis and calyces increased progressively in size and the medullary and cortical tissues decreased. The longer the time after the ligation, the more marked were these changes.

The function of the dog's kidneys was studied postoperatively by intravenous pyelography. This demonstrated that no dye appeared in the kidney after the ureter was ligated in any of the dogs. This study was made from one hour up to three days after ligation. The dye did appear, however, in normal time in the opposite kidney. (Figs. 9 and 10.) This was the same finding as in our clinical cases. The kidney of the operated side was removed at the various intervals mentioned and studied pyelographically by the retrograde method.

After ligation of the ureter it was found that in all these kidneys the pelvis and calyces showed some evidence of hydronephrosis, even though very slight. No evidence of any atrophy was observed in any of the kidneys. (Figs. 11 to 14.)

The cortex and the medullary portion of the kidney was reduced in size depending upon the elapsed time of the ligation of the ureter; the longer after the ligation, the thinner the cortex became. (Figs. 11 to 14.)

In all the cases the microscopic picture shows evidence of good-functioning glomeruli decreasing in number as there was an increase in time that elapsed after the ligation of the ureter. This same picture was found throughout the sections relative to the other structures of the kidney.

POSTOPERATIVE COURSE IN PATIENTS

All the wounds closed by first intention. Peculiarly enough while the patient had some pain after the operation, which was the result of the operation, they all claimed it was of a different type. In all, the original type and location of pain seemed to have disappeared immediately after the operation.

Postoperative studies were made while the patients were in the hospital and after they were discharged.

In the hospital, total phthaleins were given to make comparisons with the total preoperative phthaleins, and it was found that little difference was found in any of the cases.

Pyelograms of the remaining kidneys were made by the intravenous route, making it in Case 1 in twenty days, in

Case II in fourteen days, in Case III in ten days, and in Case IV in three days.

In all the cases when the pyelograms were made it was observed that no dye came through the supernumerary segment but that the dye came through the other two kidneys in normal time and that the appearance of the remaining pelves was the same as in the original retrograde pyelograms.

The patients were discharged in from twelve to twenty-one days.

Relative phthaleins were not made until after the patient left the hospital as is seen in the case histories.

POSTOPERATIVE COURSE IN THE DOGS

All but two dogs lived, and were kept under observation for other studies. In the two dogs that died one evicerated after pulling his dressings off and the other died under the anesthetic. The wounds of the others healed by first intention and there was no evidence of peritonitis.

FOLLOW-UP COURSE

After the patients left the hospital, the urines were studied on various occasions and in no case had the urine become infected.

Relative phthaleins were made at various intervals from thirty to ninety days after discharge from the hospital. It was observed that in all the cases the phthalein of the remaining portion of the supernumerary kidney had increased in amount and remained so.

The pain, which was the chief complaint, had disappeared and in no case had it returned after seven years, which is the longest time of follow-up of the first case. One patient complained of a slight discomfort in the operative region, but claimed it was different in character.

COMMENT

In the discussion of this problem we believe that the pain probably originated in the supernumerary segment and was due to an intermittent hydronephrosis which was caused by slight obstruction in the supernumerary ureter. Since the ureters were not completely obstructed, these patients had their pain only when urinary stasis existed in the supernumerary segment as is found frequently in renal colic or in Dietl's crisis. When this pelvis emptied, they were relieved of pain. We also know that cases of intermittent pyelectasis give more pain than those that have continued pyelectasis. The only reason that can be given for the relief of pain after ligating the supernumerary ureter in these patients is that a complete obstruction is produced, an early hydronephrosis results, gradually causing destruction to the functioning glomeruli with the quick and early result that a non-functioning renal segment is produced. As soon as the non-functioning segment is produced and is uninfected it causes no disturbance in the body. We have seen this only too frequently in our experience.

RESULTS IN CLINICAL CASES

From this study it has been observed that after an ureter is ligated and cut a hydronephrosis immediately starts. Although this never assumes a very large size, it is present. This is borne out by the experimental work on the dogs. Whether it goes on ultimately to atrophy, we are unable to state as we had not carried on our experiments for a sufficient length of time. From a functional standpoint, the urine ceases to secrete very shortly after ligation which was also borne out by the experimental work, so that when an intravenous pyelogram was made, no dye was found in the kidney pelvis or calyces. The earliest that this was demonstrated in the human was three days, whereas in the animal it was within one hour.

The pain appears to subside almost immediately after the ligation, although there was some ache in the lumbar region for about three months in two of the cases

but was described as a different type of pain. In all probability, this was a post-operative ache that may be encountered following any operation.

These cases have been followed from six to seven years.

In all the cases, the patients were able to return to their normal duties and accomplish them in a much better fashion than ever before.

CONCLUSIONS

1. Lumbar discomfort renal in origin, in the presence of an uninfected supernumerary renal segment, is relieved by permanent ligation of the supernumerary ureter.

2. The operation has been performed four times on three patients with good results.

3. All other methods of treatment should be tried first.

4. The function of the supernumerary segment ceases within several hours after the ligation of the ureter. This has been verified clinically by intravenous pyelography and supported experimentally on dogs.

5. The ultimate outcome of the supernumerary segment is a mild hydronephrosis and then a non-functioning renal segment.

6. The function of the remaining kidney on the same side is undisturbed or improved, supported by a functional test of phenosulphonphthalein and intravenous pyelography in the human and dogs.

7. The remaining kidney does not become hydronephrotic, supported by intravenous and retrograde pyelographic observations on the human and dog.

8. Three patients upon whom the operation was performed four times (bilateral in one case) have been relieved for as long as seven years.

Our appreciation is extended to Dr. H. H. Spencer of the Pathological Department, and Dr. G. H. Yeager and Miss M. Hickman of the Experimental Operative Surgical Department of the University of Maryland, also to Miss A. Fishpaugh of the Roentgenological Department of the Sinai Hospital for their cooperation and valuable services rendered in the completion of this work.

REFERENCES

1. GOLDSTEIN, A. E. and SHAW, C. C. Bilateral supernumerary fused kidneys with bilateral reduplication of ureters. *Urol. & Cutan. Rev.*, vol. 41.
2. VICTORIUS-MEDORI, F. DE. On early atrophy of the kidney without hydronephrosis following ligature of the ureter. *Policlinico*, 44: 1–12, 1937.

INTERVERTEBRAL SPINE FUSION WITH REMOVAL OF HERNIATED INTERVERTEBRAL DISK*

J. M. OVENS, M.D.
PHOENIX, ARIZONA

AND

LIEUT. COMDR. H. G. WILLIAMS
MEDICAL CORPS, UNITED STATES NAVY

THE symptoms due to herniation of an intervertebral disc, or discs, are relieved by removal of the herniated disc or discs sufficiently to have no recurrent herniation of the remaining portion. Theoretically, but not actually, the articular cartilages on the bodies of these two vertebrae then fuse, preventing motion at this spot. Actually this does not always happen. Even when the intervertebral space has been well cleansed of all nucleus and annulus that it is possible to remove, and a generous amount of the articular surfaces has been removed, ankylosis of the adjoining vertebral bodies frequently does not occur and there remains motion in this joint space. Besides this, the joint space may be greatly narrowed. Together with the narrowing of the space between the bodies of the vertebrae there occur changes in the region of the articular facets and intervertebral foramen. These consist of slight slipping of the articular facets, and narrowing of the intervertebral foramen.

The cause of persistent or recurring pain after intervertebral disc operations may be any one of the following: (1) Removal of the wrong disc, (2) removal of an insufficient number of herniated discs, (3) recurrence of the herniation when the intervertebral disc has been incompletely removed, (4) arthritis of slipping in the region of the articular facets in the area involved, and (5) narrowing of the intervertebral canal with nerve root pressure. It is with the last three causes that this paper is concerned. Removal of insufficient number of discs necessitates reoperation.

Recurrence or herniation of the remaining intervertebral disc, facet syndromes due to slipping or arthritis of the facets, or root pressure syndromes with root pain due to narrowing of the intervertebral canal, can all be prevented by anticipating their occurrence and preventing such, by use of intervertebral bone grafts. We first began using intervertebral bone grafts approximately one year ago, after having operated upon two patients in succession for recurrence of the herniation. In both of these the posterior longitudinal ligament had a rather large opening in it, and the nucleus projected itself out through this opening. Removal of this remaining portion of the disc was comparatively simple after the approach to the disc through the adhesions was made. In order to prevent a recurrence we removed a portion of the spinous process of the vertebra involved, and after thoroughly curetting the cartilage from the adjacent vertebral bodies and cleansing this portion of the spinous process well, placed it through the opening in the posterior longitudinal ligament and then turned the graft sideways so that it could not extrude itself again. Both of these patients had uneventful recoveries and have been entirely free from symptoms ever since. It occurred to us that pain which we contributed to facet syndrome and root pain persisting after the operation could also be prevented by building up the joint space between the adjacent bodies of the vertebra and by fusing this space to prevent motion at this joint. This we have been doing for the past year according to the following technic, as illustrated in the following case reports:

CASE REPORTS

CASE 1. Mr. M. G. was injured when he fell through a hole between a truck and shipping

* From the section on surgery the Lois Grunow Memorial Clinic, Phoenix, Arizona.

dock and struck his left ichial tuberosity on the loading deck. His subsequent course was characterized by limitation in motion of the spine, scoliosis, sciatic pains in the left leg and atrophy of the left thigh and calf. Myelograms revealed a left-sided defect at the lumbosacral space. At the time Mr. G. was operated upon he was nearly invalided. The operative report is as follows:

Incision was made over the lower lumbar and sacral spines. Hemostasis was secured with electrocoagulation and towels applied to the skin. Muscles were dissected free from the left side of the spinous process and the laminae. The lumbosacral area was well cleansed. Laminectomy retractors were inserted and the lower portion of the fifth lumbar lamina on the left was nibbled away. The ligamentum flavum was removed exposing the extradural fat which was also removed. The dura and exiting nerve root were retracted medially. The disc was exposed very well and presented itself as a 4 by 5 mm., pearly, hard cartilaginous tumor. A circular incision was made in the posterior longtitudinal ligament and the nucleus pulposis ejected slightly. The nucleus was removed with curet and forceps. The cartilage on the inferior portion of the fifth lumbar body and superior portion of the sacrum was removed by thorough curettment. A small segment of the spinous process of the fifth lumbar vertebra was removed. This was approximately 10 by 4 by 3 mm. in size. The bone removed by ronguering away the lower portion of the fifth lamina on the left, and this oblong-shaped graft, was inserted into the intervertebral space. The segment removed from the spinous process was inserted lastly. The wound was thoroughly irrigated with saline and closed in the routine manner.

The patient left the hospital less than three weeks afterwards and since then has had no back pain, no sciatic pain and is now entirely free from his former marked sciolosis. *X*-rays taken ten weeks later showed, as yet, incomplete fusion of the lumbosacral joint space. The joint space is not narrowed.

Case II. Mr. J. H. was injured when he was lifting a barrel of oil and slipped, coming down in a sitting position on a concrete floor. Following the accident he had persistent low back pain with sciatic distribution of pain in the left leg. He had slight atrophy of the left thigh and left calf. There was anesthesia over the anterior and lateral portion of the left lower leg beginning about two inches below the knee and extending into the fourth and fifth toe. There was pain over the distribution of the sciatic nerve and the Achilles' reflex on the left was diminished. Oleomyelograms done with lipiodol on this patient revealed a filling defect between the third and fourth lumbar vertebra on the left.

The patient was operated upon as follows: The routine incision was made and the muscles stripped from the left side of the spinous processes and the lamina of the third, fourth, and fifth lumbar vertebra. The lower part of the fourth lumbar lamina on the left was then rongeured away, the ligamentum flavum removed, and the spinal canal entered. There was found a disc here which extruded slightly. The posterior longitudinal ligament was incised and a circular area removed from this structure. The herniated nucleus as well as the annulus fibrosis was removed with forceps and curet. The articular surfaces on the adjacent vertebral bodies were thoroughly curetted away. The entire left side of the fourth lamina was then removed and the third intervertebral space inspected. The third space was found to have a ligamentum flavum which was very thick with caseous appearing material in the area between the ligamentum flavum and extradural fat. This thickened, cheesy ligamentum flavum constricted the dura here and was removed entirely. Part of the spine of the fourth lumbar vertebra was removed in approaching this region. This portion of the spinous process, as well as the tiny fragments ronguered away when the lamina was removed, was inserted into the space between the fourth and fifth lumbar vertebra, thus doing a bone graft between the bodies of these vertebra with a previously prepared spinous process segment and lamina fragments. The area was inspected for hemostasis, a thorough search was made for sponges and none were found. A routine closure was used without drainage.

The patient left the hospital at the end of three weeks and has been entirely free from pain ever since. Recheck *x*-rays revealed new bone forming in the intervertebral space and the intervertebral space is not narrowed.

As yet our results are not permanent nor can the future course of events be anticipated, however, we can say that we have

not operated upon a single person and employed this technic without excellent results. All patients on whom we have done this type of operation, we have kept in bed for three weeks in a horizontal position. We then allowed the patient to be up without a brace and advised against excessive motion in the back. We advised against heavy lifting or stooping for a period of six months. All patients have returned to their homes, if they have lived outside the city; and from written reports all are doing well. The patients in the city we have observed and none have had any remission or any recurrence of symptoms.

SUMMARY

We have here presented a preliminary report of a method of spinal fusion following removal of the intervertebral disk. We also believe that if this method is followed that there will be no recurrence following incomplete removal of a herniated intervertebral disc. There will be no symptoms persisting due to slipping, or arthritis, in the region of the articular facets. There will be no root pain persisting due to narrowing of the intervertebral foramen with root pressure. Even following the most thorough curettment, without bone grafting after the removal of an intervertebral disc, we find that fusion results in only a small number of cases, and we believe that this method will greatly increase the number of cases of fusion between the adjacent vertebra. This method appears to be the method of choice where laminectomy has been done previously for any reason whatsoever, and it is necessary to bridge a wide gap between the spinous processes. It seems that fusion between the bodies of the vertebra and at the facets is the method of choice here and should be employed. We believe that if intervertebral body fusion operation be employed along with the routine removal of herniated intervertebral disc, the number of patients who have symptoms persisting after operation will be appreciably lowered.

FRACTURE OF THE ZYGOMATIC BONE AND ARCH POSTOPERATIVE HEADGEAR

MAJOR ADOLPH A. SCHMIER
MEDICAL CORPS, ARMY OF THE UNITED STATES

FRACTURE of the zygoma is a rare entity in ordinary life. It has been reported that the incidence of fracture of the malar bone and zygomatic arch is 1:3000 cases of fracture of bones of the face. In contrast to the paucity of cases in civil medical practice, I have had the occasion to treat five patients at Station Hospital in the short period of eight months. All of them were the result of direct impact against the cheek bone which temporarily disabled them. One case presented evidence of concussion. He also had diplopia, which cleared up prior to reduction, despite a depression of the orbital floor. Two other patients also had depression of the orbital floor but without diplopia. None of the cases were compounded. All of them revealed obvious deformity of the involved side of the face, and each was corrected by open reduction and returned to duty.

ANATOMY

The zygoma, or malar bone is a small quadrangular bone which forms the prominence of the cheek, and part of the lateral wall and floor of the orbit. Its malar surface is convex anteriorly; its posterior or temporal surface is concave forming the anterior boundary of the temporal fossa above and the infratemporal fossa below. It articulates with the frontal, sphenoidal, temporal and maxillary bones by means of processes. Suture lines are present at these junctions between the frontal bone and the frontosphenoidal process of the zygoma; between the sphenoid and the orbital process of the zygoma; between the zygomatic process of the temporal bone and the temporal process of the zygoma; and between the maxilla and the maxillary process of the zygoma. These suture lines are of importance since in the majority of instances, the zygoma separates at these serrated articulations and becomes depressed. The walls of the underlying maxillary antrum may thereby become fractured and the sinus encroached upon. The body of the bone *per se* is only infrequently fractured. In addition to the separation at the suture lines, the zygomatic arch which is part of the temporal bone may be fractured and crumpled by a sharp blow. The smallest part of the process near the temporal end is the common site of fracture. The masseter muscle takes origin from the inferior surface of the zygomatic arch. The temporal fascia inserts at its superior surface.

DIAGNOSIS

The diagnosis of fracture of the zygoma and zygomatic arch is based upon the history, clinical and roentgenological findings. There is always the story of a direct blow or impact upon the cheek. The involved side of the face presents the characteristic loss of the prominence of the cheek bone with asymmetry of the two sides. Soft tissue swelling due to hemorrhage and edema may tend to obscure the diagnosis. Palpation, however, will reveal the depression of the zygomatic arch and of the orbital border if present. The roentgenograms will substantiate the clinical findings. The patient may have difficulty chewing due to spasm of the masseter muscle. In cases of depression of the orbital floor, diplopia may be present as well as infraorbital anesthesia. Unilateral epistaxis may be evident and there may be local ecchymosis as well as subconjunctival hemorrhage.

COMPLICATIONS AND INDICATIONS FOR THERAPY

Fracture of the malar bone may be accompanied by complicating fracture of the

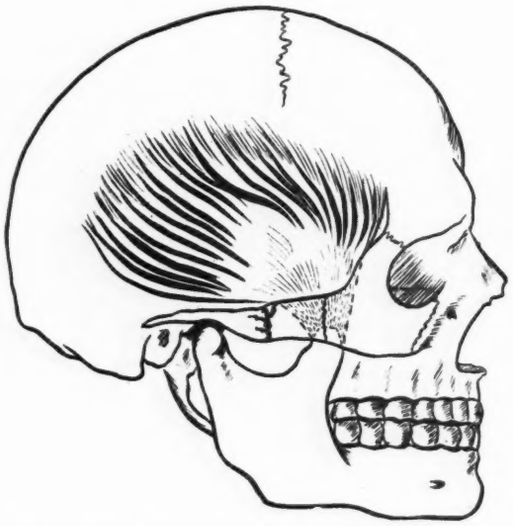


FIG. 1. Skull illustrating zygomatic suture lines; fracture of zygomatic process of temporal bone; relationship of temporalis muscle to zygomatic arch.

surrounding bones. The oribital surface of the maxilla, in addition to the orbital process of the zygoma, may be fractured and depressed, occasionally resulting in diplopia as the eyeball follows the orbital floor downward. The cause of diplopia and its significance require clarification. Broadly speaking, diplopia following a direct injury of the face and eye is due to an inability of the external ocular muscles to move the eye synchronously with the uninvolved eye. Hemorrhage and swelling into the orbital cavity may cause temporary exophthalmus with diplopia. Paralysis of one or more of the extrinsic ocular muscles may also be a cause. Depression of the orbital floor and eyeball may prevent the involved eye from focusing coordinately with the uninjured eye. Diplopia results. When diplopia exists in the presence of depression of the orbital floor, it has generally been credited directly to this depression in the past. Accordingly, immediate open reductions have been performed with surgical approaches through the buccal or nasal cavity and through the antrum, often resulting in serious, complicating infections. The depressed floor is reduced but many times incompletely. Yet the diplopia seems to disappear in most instances regardless of the degree of reduction. In view of this, I wonder whether the usual mild to moderate degree of depression of the orbital floor is the actual cause of diplopia? If the answer is doubtful does the hazard of developing an infection and chronic sinusitis warrant such an immediate operative approach? Is it not possible that most cases of diplopia are not directly associated with the depressed orbital floor? Three of the cases reported in this series had depressions of the orbital floor, yet only one had diplopia. Reduction was postponed in this case because of a concussion, and during the five days' delay the diplopia disappeared spontaneously. Had immediate reduction been performed, the operation would have been credited with correcting the diplopia. It is apparent in this case that hemorrhage and/or edema was the cause of the diplopia, and subsidence of the resulting swelling permitted normal accommodation. Delayed open operation in this case through an external potentially clean approach completely reduced the depressed zygomatic arch, but the depressed orbital floor remained unreduced. Yet diplopia did not recur, despite the fact that the orbital depression was fairly marked in degree.

It is therefore recommended that in cases of diplopia with depression of the orbital floor, any operative approach through the buccal or nasal cavity or antrum be delayed. Any of the other methods of reduction which avoid these areas may be carried out immediately, if the patient's general condition warrants; and they alone may reduce the orbital floor as well as the depressed zygomatic arch with complete correction of the diplopia. In that case the hazard of an operative approach through potentially infected tissue can be avoided. In two of the three cases in this series with depression of the orbital floor, almost complete reduction of the orbital floor was obtained along

with complete reduction of the arch by the Gillies method. The diplopia may disappear even though the orbital floor is incompletely reduced or even unreduced. Unless the depression of the orbital floor is considerable, it does not appear to be a complicating factor functionally and therefore will probably not cause any disability in vision. The position of the eyeball will not change permanently unless the orbital contour is greatly altered. In those cases in which diplopia still persists, it will be necessary to reduce the orbital floor secondarily. Even then operative approaches which avoid the antrum and nasal cavity are preferable in order to prevent serious infection. The available methods will be discussed under therapy. The delay occasioned by originally avoiding the buccal, nasal or antral approach should not make reduction more difficult. In one of the cases in this series, reduction was performed thirteen days following injury without difficulty. A second case was reduced twelve days after injury without any undue effort.

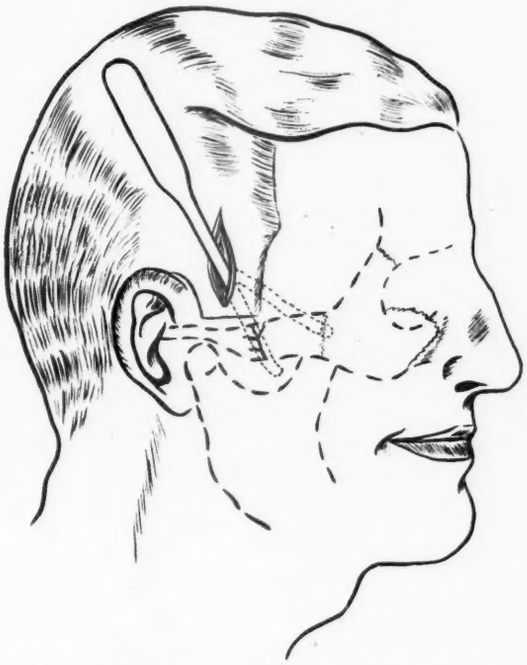


Fig. 2. Gillies temporal approach for reduction of fracture of zygomatic arch and depression of malar bone.

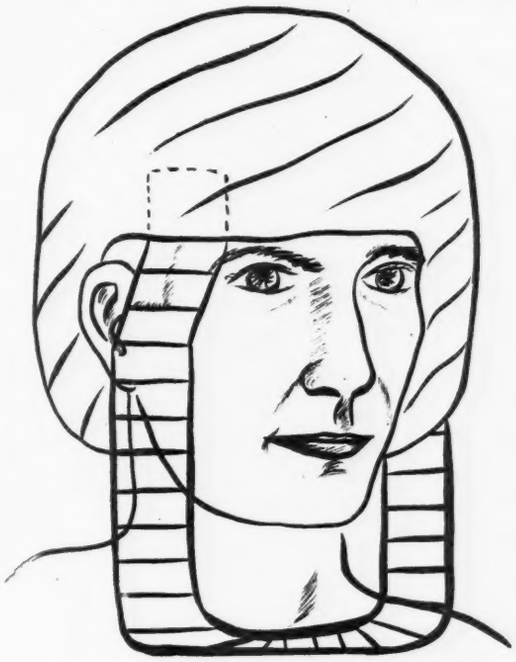


Fig. 3. Postoperative plaster of Paris headgear with wire ladder splint incorporated.

In those cases in which the fracture involves the orbital floor, especially where depression is present, the infraorbital nerve may be impinged upon either within its canal or at the infraorbital foramen. Neuroma formation may occur, necessitating excision of the nerve at its exit through the foramen in order to relieve the patient of pain. This, of course, results in anesthesia of the upper lip and a triangular area on the face below the eye with its apex at the foramen.

In complicated cases, the general condition of the patient influences the immediate course of therapy. Compound fractures require débridement and removal of foreign material in addition to reduction and immobilization of the fracture. In cases with complicating nasal fractures, hemorrhage may be sufficient to obstruct nasal breathing. Packing may be necessary to control bleeding and a tracheal tube passed through the mouth may be essential where the airway is obstructed. Tracheotomy may even be necessary.

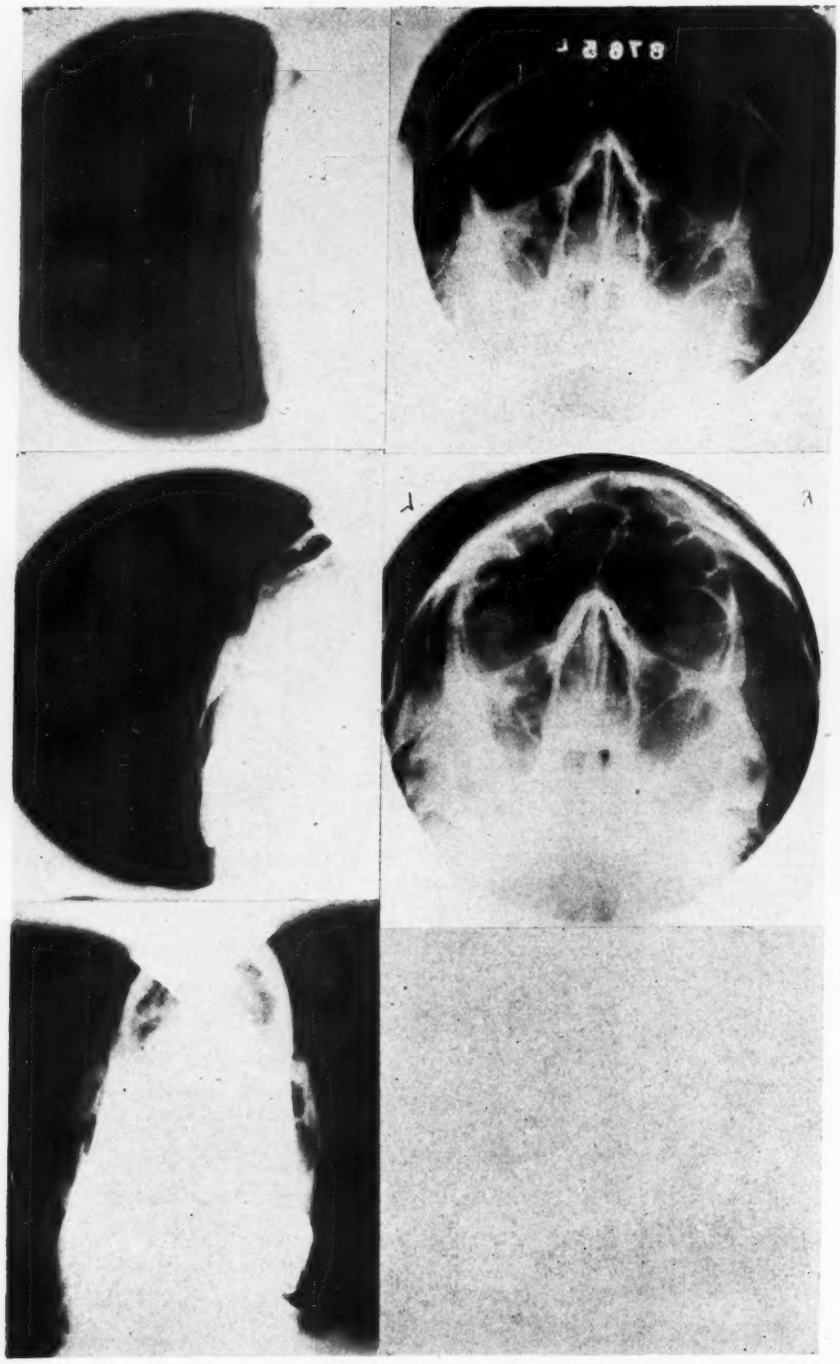


FIG. 4. CASE 1. *Upper left:* Tangential view with depression of zygomatic arch, left. *Upper right:* Postero-anterior oblique view revealing fractures at zygomaticofrontal and zygomaticotemporal suture lines as well as depression of orbital floor. *Middle left:* Complete reduction of arch. *Middle right:* Practically complete reduction of orbital floor. *Lower left:* Composite view showing symmetry of arches bilaterally following reduction.

TREATMENT

Reduction of fractures of the zygoma and zygomatic arch should be accomplished as early as possible, just as in fractures elsewhere, and by the safest method available. Its purpose is to restore normal function of the mandible and eye and normal facial contour. Undue delay in reduction permits increased local soft tissue reaction and fixation of the displaced fractured fragments. In cases of persistent ocular changes, failure of reduction may cause these to become permanent.

The following is a brief description of the many methods of reduction that have been described:

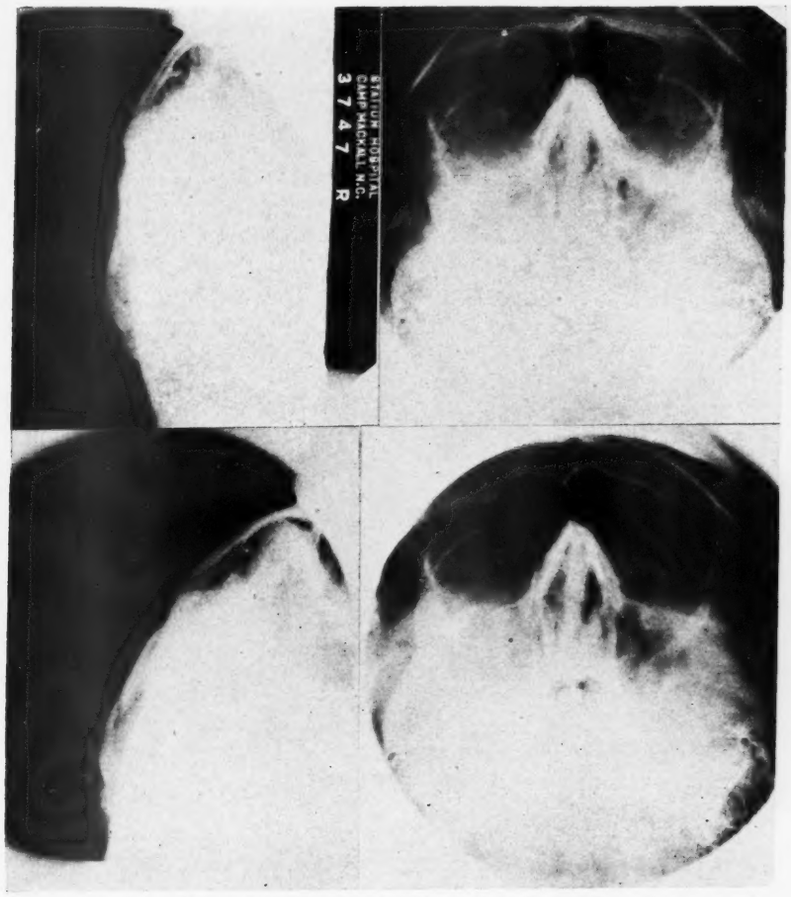


FIG. 5. CASE II. *Upper left:* Tangential view with depression of zygomatic arch, right. Note complete fracture at zygomaticotemporal suture line, as well as incomplete fracture through zygomatic process. *Upper right:* Postero-anterior oblique view. Note fractures at zygomaticofrontal and zygomaticotemporal suture lines with marked depression of arch; also mild depression of orbital floor and marked clouding of antrum. *Lower left:* Complete reduction of arch. *Lower right:* Practically complete reduction of orbital floor. Note reduction of zygomatic arch in this view.

1. The sharp prongs of a towel clip are inserted percutaneously to grasp the depressed zygomatic arch for traction and reduction. In my experience, the strongest towel clip is not sturdy enough. It bends out of shape during traction and suddenly loses its grip on the bone causing a slight jagged tear in the skin.

2. Reduction may be accomplished by inserting a corkscrew through a small skin incision to the depressed bone for traction and manipulation according to the method of Roberts. Rarely is it necessary to employ a narrow chisel to loosen the line of fracture to permit elevation of the depressed bone.

3. In some old cases, it may be necessary to cut down on the fracture site and free it with an osteotome in order to obtain reduction. Wiring may then be necessary for retention.

4. In the method of Matas, a silver wire is passed around the zygomatic arch by means of a curved cutting edge needle. Traction is applied and maintained through the wire, which is attached to a splint placed over the arch.

5. Ivy and Curtis insert a one-inch, ordinary screw-eye into a small drill hole into the zygoma through a small incision over the bone. By means of a plaster head cap, containing a side arm of heavy wire, elastic band traction is applied to the depressed zygoma through the screw-eye.

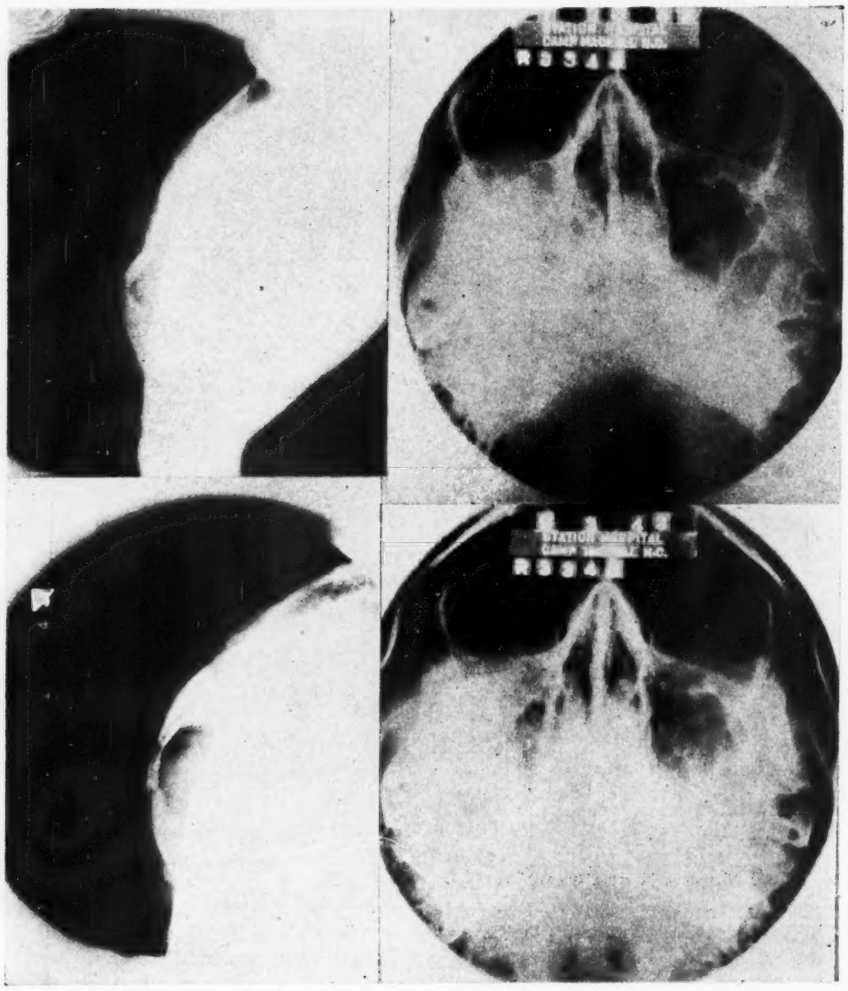


Fig. 6. Case III. *Upper left:* Marked depression of right zygomatic arch with complete fractures at zygomaticotemporal suture line and through zygomatic process. *Upper right:* Note fractures at zygomaticofrontal and zygomaticotemporal suture lines, as well as through zygomatic process with depression. Orbital floor is markedly depressed and antrum is cloudy; diplopia is present. *Lower left:* Complete reduction of zygomatic arch. *Lower right:* Note complete reduction of arch but practically no change in position of orbital floor. Diplopia disappeared prior to reduction; antrum is clearing.

6. A steel sound or other sturdy blunt instrument is passed through a small incision in the buccal fold and under the zygomatic arch. Leverage produces reduction.

7. Where the orbital floor and border are depressed, the steel sound can be passed through a small incision into the buccal fornix over the canine fossa and into the

antrum for reduction. External palpation along the orbital border indicates the degree of reduction.

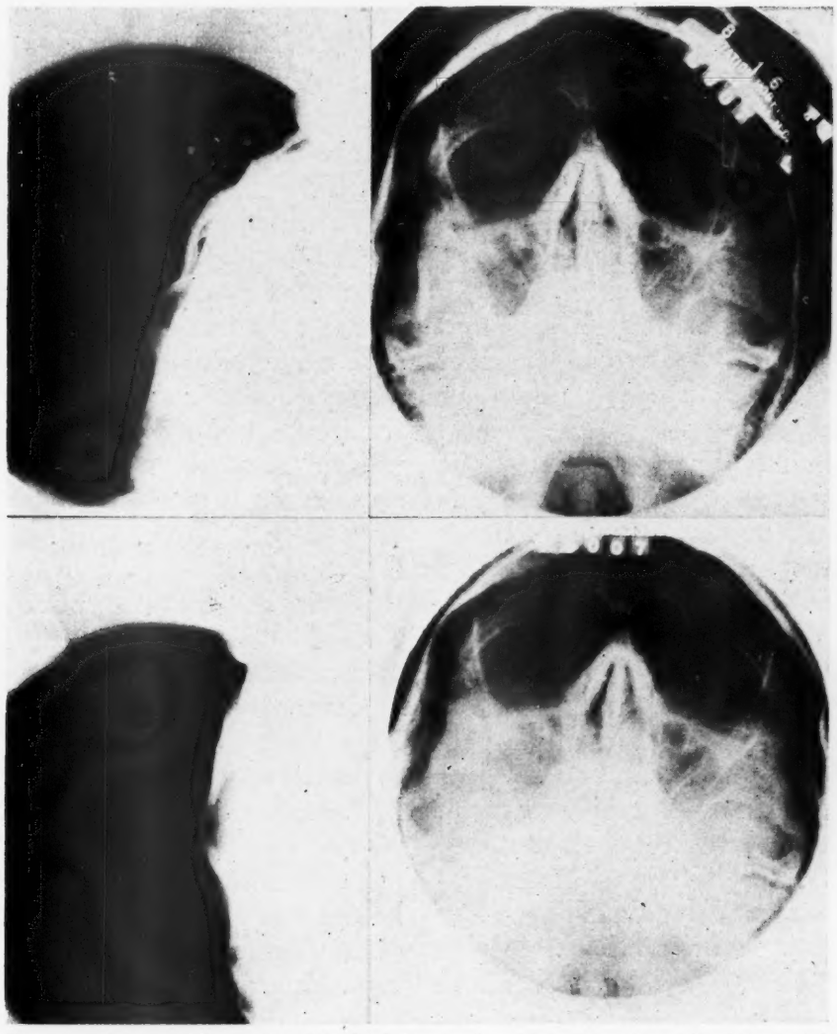


Fig. 7. Case iv. *Upper left:* Marked depression of zygomatic arch, right, with complete fractures at zygomaticotemporal suture lines and through zygomatic process. *Upper right:* Note marked depression of arch with fractures at zygomaticofrontal and zygomaticotemporal suture lines as well as through the zygomatic process. The orbital floor is intact. *Lower left:* Reduction of arch not quite complete. Cosmetically, the result was good. *Lower right:* Almost complete correction of arch noted in this view.

8. Baxter employs an intrabuccal approach but avoids the antrum. The depressed fracture is reduced by means of an elevator at the fracture site. Reduction is maintained by a metal splint which is wired to the teeth and which supports the depressed zygoma until union occurs.

The last three methods traverse the buccal cavity in order to obtain reduction. The transantral approach, either from the buccal or nasal cavity has been reported to be advantageous since it permits removal of blood clot from the antrum at the time of operation. There is no necessity for entering the antrum to remove the blood clot, since serial postoperative roentgenograms show that it is absorbed and disappears spontaneously. In patients treated by the transantral route, the antrum is irrigated regularly for several weeks postoperatively. The danger of antral irrigations in these cases cannot be overemphasized, and cases of maxillary sinusitis have been reported.

There is even a far greater danger of irrigating pathogenic organisms from the antrum through the fracture site into the orbit, causing orbital infection. Orbital cellulitis and even meningitis may result. The danger of serious infection by this approach has been previously emphasized and should, therefore, be avoided if possible. Operative procedures conducted through a clean field are safer and less likely to be followed by infection. The following method fulfills this requirement and has met with success generally.

9. The method of Gillies, Kilner and Stone is simple yet effective in cases of depressed fracture of the arch alone or combined with depression of the orbital floor. It is the method employed in all five of the patients treated in this series. The reduction should be performed as soon as possible unless there is contraindication due to the general condition of the patient. Generally, the earlier the reduction, the easier it is. However, one case reduced the same day of injury required considerable leverage force for reduction, due to impaction and marked depression. Loud crepitus could be felt and heard during reduction. Conversely, one fracture was reduced thirteen days after injury without difficulty and a second twelve days days after injury with ease. The reduction is carried out through a clean field, and is therefore preferable to the procedures carried out through the buccal cavity. It is also preferable to the procedures requiring incisions directly over the zygoma, since the latter convert a simple into a compound fracture, with the compounding directly over the fracture site. With the Gillies method, therefore, there is much less likelihood of postoperative infection.

TECHNIC

The temporal region is shaved and prepared. A longitudinal incision ½ to ¾ inch long is made in the temporal region within the hairline. The longitudinal incision is preferred to a transverse incision, since there is less likelihood of injury to the superficial temporal artery and auriculotemporal nerve. It is important that the incision be extended deeply through the temporal fascia, exposing fibers of the temporal muscle. A steel sound, Kelley clamp, or narrow periosteal elevator is then passed downward and forward superficial to the temporalis muscle and deep to the fascia into the temporal fossa beneath the depressed zygoma. The temporal fascia which covers the muscle attaches to the superior border of the zygoma and zygomatic process of the temporal bone. If the sound is not inserted beneath the fascia, but remains superficial to it in its passage downward and forward, it will not reach the temporal fossa behind the depressed bone. In its proper position, the steel sound is now employed as a lever to elevate the zygoma with the skull as a fulcrum. A folded gauze pad is placed over the skin beneath the sound to avoid untoward local pressure. The amount of force necessary to elevate the depressed bone varies with the amount of depression and impaction. Considerable strength is often required. At times the skull alone is inadequate as a fulcrum. A second sound placed over the padded region at right angles and beneath the inserted sound, may be necessary to act as a fulcrum in order to obtain sufficient levering force for reduction. External palpation along the zygoma and orbital border gives clinical evidence of the completeness of reduction. The sound is now withdrawn and the skin closed with one or two sutures. A collodion cotton dressing is applied.

As in any other type of fracture, maintenance of reduction is all important. If there is a tendency for the deformity to recur immediately after elevation of the depressed bone, either open reduction and wiring of the fragments will be necessary, or the traction methods of Matas or Ivy and Curtis can be employed. Traction of from four to seven days is generally sufficient to fix the fragments in place. None of the patients in my series required this. However, even when the elevated bone

retains its reduced position, one must guard against subsequent postoperative pressure producing a redisplacement of the fractured fragments. Because of fear that the patient may cause local pressure over the cheek bone during his sleep, a protective appliance is deemed necessary. A plaster-of-Paris headgear is applied, incorporating a wire ladder splint in such fashion as to have it extend from the temporal region on one side down over the same side of the face, under the chin and up over the opposite side of the face to be incorporated into the plaster at the opposite temporal region. The wire extends far enough under the chin so as not to interfere with motion of the mandible.

CASE REPORTS

CASE I. This patient was admitted to the hospital on October 21, 1943, with a history of having been struck on the face on October 9, 1943.

He presented an asymmetry of the face with depression of the left zygoma as well as the zygomatic arch. Local tenderness was present as well as ecchymosis. The left upper eyelid was swollen and discolored, but vision was normal. *X*-rays revealed a fracture of the zygoma at the zygomaticofrontal suture as well as the zygomaticotemporal suture line. The zygoma as well as the zygomatic arch were depressed with moderate depression of the orbital floor. The latter indicates a fracture of the zygomaticosphenoidal suture line also. Mild clouding of the antrum indicated some hemorrhage.

Open reduction was performed on October 22, 1943, under sodium pentothal intravenous anesthesia by the Gillies method. Excellent reduction of the depressed zygomatic arch was obtained and practically complete reduction of the depressed orbital floor. The ½ inch incision healed by primary union and the normal contour of the face was restored. Check-up *x*-ray revealed the clouding of the antrum to have disappeared. On November 17, 1943, the patient had no complaints and he was referred to the rehabilitation section for return to regular duty.

CASE II. This patient was admitted to the hospital on June 19, 1943, with a history of having been thrown into a tree by another soldier while running to the mess hall. He struck the tree with the right side of his face. The injury occurred on the date of admission.

Examination revealed marked depression of the right cheek in the region of the zygomatic process of the temporal bone primarily, but extending forward toward the zygoma. Marked tenderness was present. There was some dried blood in the right nasal cavity, but there was no evident deformity of the nose. Mild local tenderness was present and vision was normal. Roentgenograms revealed a fracture of the zygoma at the zygomaticofrontal and zygomaticotemporal suture lines. There was also an incomplete fracture of the zygomatic process of the temporal bone. Mild depression of the orbital floor indicated a disruption of the zygomaticosphenoidal suture line. There was definite clouding of the antrum indicative of hemorrhage.

The patient was removed to the operating room immediately where open reduction was performed under local novocaine anesthesia by the Gillies method. A considerable amount of force was required, and during reduction bone grating could be felt and heard. The patient developed a moderate amount of postoperative swelling and ecchymosis, but these gradually disappeared. The ¾ inch incision healed by primary union and asymmetry of the face was completely corrected. Roentgenograms revealed excellent reduction of the zygomatic arch and practically complete correction of the orbital floor. On July 31, 1943, the patient had no complaints and the fracture was clinically united. He was returned to regular duty following a convalescent furlough.

CASE III. This patient was admitted to the hospital on July 22, 1943, with a history of having been struck on the right side of the face with an unknown object by another soldier.

Examination revealed the patient to be markedly dazed. There was moderate swelling of the cheek but palpation revealed the depression of the zygoma as well as the orbital floor. Vision was interfered with and the patient had diplopia. In view of the concussion, reduction was delayed and the patient was put at rest. Roentgenograms taken four days later revealed the fracture of the zygoma at the zygomaticofrontal and zygomaticotemporal suture lines. It also revealed a fracture through the zygomatic process of the temporal bone with marked depression of the arch. The orbital floor was

also markedly depressed and clouding of the antrum indicated hemorrhage therein.

The patient's general condition improved and despite the considerable depression of the orbital floor, the diplopia had disappeared by July 26, 1943.

Accordingly on July 27th an open reduction was performed under local novocaine anesthesia. The sharp points of a sturdy skin clamp were forced through the skin and soft tissue over the medial portion of the right zygoma, just lateral to the zygomaticomaxillary junction. The zygoma was grasped with this instrument, one prong fixing the bone beneath the orbital border and the other prong under the inferior border of the zygoma. With firm steady traction forward, the zygoma was felt to give and be lifted from its depressed position. The jagged edge previously felt at the orbital border had disappeared. However, the depression of the lateral portion of the zygoma and zygomatic process of the temporal bone still remained. This could not be further corrected by the towel clamp, since its prongs would bend and slip when traction was applied. The Gillies method was therefore employed for further correction. It was noted that there was a tendency for the elevated arch to fall back again each time leverage was removed, but finally the clinically reduced fragments retained their corrected position. Immediate check-up *x*-ray revealed excellent reduction of the zygomatic arch. A plaster-of-Paris headgear with ladder wire splint was applied. The patient removed this the following night, however, because of moderate postoperative swelling. It was subsequently reapplied. Check-up roentgenograms taken September 3, 1943, still revealed the excellent reduction of the zygomatic arch, but little if any correction of the depressed orbital floor. Despite this, however, the diplopia did not reappear. The clouding of the antrum had faded almost completely. The patient was returned to regular duty.

Case IV. This patient was admitted to the hospital on August 16, 1943, with a history of having been struck on the face during a friendly scuffle the same day.

Examination revealed the usual findings characteristic of a depression of the zygomatic arch. There was no diplopia. The roentgenograms revealed a marked depression of the arch without depression of the orbital floor on the right side. There was a fracture of the zygoma at the zygomaticofrontal and zygomaticotemporal suture lines with marked depression at the latter site. In addition there was also a fracture of the zygomatic process of the temporal bone.

Open reduction was performed on August 18th under sodium pentothal intravenous anesthesia by the Gillies method. Palpation indicated a complete reduction, although check-up *x*-rays indicated that the reduction was not quite complete. Cosmetically, however, the asymmetry of the face was corrected and the patient had no residual symptoms. The ¾ inch incision healed by primary union. He returned to regular duty on October 26, 1943.

Case V. This patient was admitted to the hospital on October 3, 1943, with a history of having been struck in the face the same day during an altercation with another soldier.

Upon examination he presented the characteristic clinical evidence of a depressed fracture of the left zygoma. His face was considerably swollen, however, and there were several small lacerations over both sides of the face, lips, and eyes. There was no diplopia, however.

In view of the marked local reaction, it was deemed advisable to delay reduction until the swelling had subsided and the wound appeared in better condition. The wounds were cleansed and dressed. On October 15, 1943, open reduction was performed by the Gillies method and complete correction was obtained without difficulty, despite the delay of twelve days. The patient made an uneventful recovery and returned to regular duty on December 18, 1943.

COMMENT

Although fractures of the zygoma are rarely encountered in civilian life, a series of five patients was treated at a Station Hospital in the short span of eight months. The etiological factor is a direct blow or impact. The body of the malar bone is rarely involved, but the fracture usually takes place at the suture lines which join the zygoma with the frontal, sphenoidal, maxillary and temporal bones. In addition, the zygomatic process of the temporal bone may also be fractured and depressed. Diplopia may be a complication but it does not appear to be directly related to the

depression of the orbital floor. At least all cases having depression of the orbital floor do not have diplopia. Also in many cases with diplopia, this complicating symptom disappears without the orbital floor having been reduced either in part or whole. It appears that the diplopia may be due to incoordination of the extra-ocular muscles as a result of hemorrhage and edema. Given adequate time for the edema to subside and the hemorrhage to absorb, the diplopia may clear up in most cases with mild or moderate depression of the orbital floor. The necessity of surgical approaches through the buccal cavity and antrum to correct this depression can therefore be avoided, since its presence in mild or moderate degree is innocuous. In addition, the extra-oral approach of Gillies gives excellent reduction of the zygomatic arch and adequate reduction of the orbital floor in most instances. Five cases have been reported with good reduction in all instances by this method. A plaster headgear with ladder wire splint incorporated has been described for postoperative protection of the reduced zygomatic arch.

REFERENCES

Baxter, Hamilton. A new method of treatment of depressed fracture of the zygomatic bone. *Canad. M. A. J.*, 44: 5–9, 1941.

Johnson, V. Earl. Early care of depressed fractures of the malar bone. *J. Med. Soc. New Jersey*, 38: 113–117, 1941.

Key, John Albert and Conwell, H. Earle. The Management of Fractures, Dislocations, and Sprains. 3rd ed. St. Louis, 1942. C. V. Mosby Co.

Smith, Ferris. Manual of Standard Practice of Plastic and Maxillo-facial Surgery. Philadelphia, 1942. W. B. Saunders Co.

Padgett, Earl C. Surgical Diseases of the Mouth and Jaws. Philadelphia, 1938. W. B. Saunders Co.

ACUTE SUPPURATIVE AND GANGRENOUS CHOLECYSTITIS

NATHAN BLUMBERG, M.D. AND LOUIS ZISSERMAN, M.D.
Senior Attending Physician, Jewish Hospital — Associate in Medicine, Jewish Hospital
PHILADELPHIA, PENNSYLVANIA

THE published literature on gallbladder disease is voluminous. Much has been written on the acute condition of the gallbladder and experimental work has been done suggesting that the underlying pathology is usually a mechanical obstruction to the cystic duct with edema and ischemia of the vesicle wall followed by a secondary infection.[25]

Opinion has clashed sharply over the policy of immediate or delayed surgery in cases of acute cholecystitis and the relative surgical risks involved, the former policy committing the surgeon to the routine necessity of operating in a septic edematous field while the latter opinion subjects the patient to the dangers of a lesion that may be progressive.[1,3,6,8,11,12,26]

It has been shown that acute cholecystitis can resolve itself into two types of end results, namely, a spontaneous resolution without surgical interference, and a progression with termination in gangrene or empyema. It was, therefore, deemed wise to study a group of patients showing such advanced disease as empyema and/or gangrene, with or without perforation of the gallbladder wall.

MATERIAL

The material used was from the files of the Jewish Hospital, a general hospital with an adult surgical and medical capacity of 224 beds. The records of this institution for a fifteen-year interval (1929 to 1944) were searched and the charts of all patients carefully reviewed that seemed to come within the scope of this study. Only those charts were considered in which the diagnosis was definitely established either by operation or autopsy.

The pathological report was considered the correct final diagnosis. This, however, was not always available as in those patients in whom a cholecystostomy was performed no tissue was removed. Here the diagnosis accepted was the one made at the operating table. Because of the diversity of nomenclature employed by different examiners, it was decided to include as one group all patients, whether purulent or gangrenous, under the heading of Advanced Gallbladder Disease. Those patients showing either an acute perforation of the gallbladder or an old chronic one with localized abscess formation were classified as Advanced Gallbladder Disease —Perforated.

ADVANCED GALLBLADDER DISEASE— HISTORY AND SYMPTOMS

There were eighty-two such cases of whom thirty (37 per cent) were males and fifty-two (63 per cent) females. It is interesting to note that there were approximately one and one-half times as many women as men in this series, the same incidence with which cholelithiasis was found to be present in this hospital in a study of routine necropsies.[4]

Patients ranged in age from twenty-nine to seventy-two years with an average age of 53.3 years for the men and 55.9 years for the women.

Fallis and McClure[9] reviewed 320 cases of acute cholecystitis and found that the disease occurred twice as often in females as in males. Judd and Phillips[16] reported on 508 consecutive patients with acute cholecystitis who came to operation, 40 per cent of whom were men.

In a survey of several hundred gallbladder operations, Russo[19] found that

females outnumbered the males by 6 to 1 in the chronic cases but only 2 to 1 in the acute cases.

This is at variance with the report of Glenn and Moore[10] who discussed eighty-four cases of gangrene of the gallbladder, forty-four of whom were women and forty men, although the ratio of men to women in 1,500 chronic cases was only 1 to 4.

Table 1
ADVANCED GALLBLADDER DISEASE—INCIDENCE
(Acute Suppurative and/or Gangrenous Cholecystitis)

Age	Males		Females		All	
	No. Cases	Per Cent	No. Cases	Per Cent	No. Cases	Per Cent
20–30	1	3.3	1	1.9	2	2.4
31–40	5	16.7	6	11.5	11	13.4
41–50	7	23.3	7	13.5	14	17.1
51–60	5	16.7	19	36.6	24	29.3
61–70	11	36.7	15	28.8	26	31.7
71–80	1	3.3	3	5.8	4	4.9
81–90	0	0.0	1	1.9	1	1.2
Total	30	100.0	52	100.0	82	100.0

Taylor[24] studied 129 cases of acute cholecystitis and 20 per cent of the total were men; sixty were acutely suppurative with an average age of 43.7 years. He also discussed twenty-nine cases of acute gangrenous cholecystitis with an average age of 50.8 years for the entire group, 38 per cent of them males.

Steinke[22] reported on 200 cases of acute cholecystitis 27 per cent of whom were men. There were thirty cases of advanced gallbladder disease in his series and males constituted 43 per cent of this segment. The average age of the advanced group was 47.3 years.

In our group presented for discussion, a history of symptoms referable to the biliary tract and experienced prior to the present attack was given by fifty-four patients (66 per cent) while only six patients definitely denied such symptoms. The history in the remaining cases was rather vague.

Many of the patients gave a history of gallbladder disease of moderate severity extending over a great many years, in some instances for as many as twenty years. It is interesting to realize that many people knowingly preferred to suffer for so long rather than submit to surgery and the reasonable assurance of lasting relief.

Fallis and McClure[9] found that only 12.5 per cent of their 320 patients with acute cholecystitis had no previous warning of gallbladder disease. Many of their patients had had one or more previous attacks over a period of many years. Of their entire group, 86.8 per cent had had prior medical management for gallbladder disease. Judd and Phillips[16] found that although 248 (49 per cent) of their 508 operative cases of acute cholecystitis were having their first attack, only five patients gave no history of prior symptoms referable to gallbladder disease.

Table II
ADVANCED GALLBLADDER DISEASE
(Acute Suppurative and/or Gangrenous Cholecystitis)
Duration of Present Attack

Days	Males	Females	Total
1	1	0	1
2	1	3	4
3	3	7	10
4	3	3	6
5	1	1	2
6	2	3	5
7	2	4	6
8–10	4	11	15
11–14	3	7	10
15–21	2	3	5
over 21	2	10	12
Indefinite	6	0	6
	30	52	82

The interval between the onset of the present attack of pain and its termination by either operation or an antecedent demise we found to average twelve days for the men and thirteen and one-half days for the women. Some of the operative delay was deliberate since it was the common practice in this hospital to operate on acute gallbladder patients only if

deemed necessary by the presence of a progressive lesion and, instead, to follow the conservative plan of waiting for subsidence of the acute symptoms whenever feasible.

The abdominal pain in our patients usually originated either (1) in the right upper quadrant, (2) in the epigastrium, or (3) as a generalized abdominal pain. Radiation of the pain was present in about 50 per cent of the patients and was usually referred to the back, right shoulder or across the upper abdomen; only a few patients gave a story of radiation to the left shoulder.

TABLE III
ADVANCED GALL BLADDER DISEASE
(Acute Suppurative and/or Gangrenous Cholecystitis)
Localization of Abdominal Pain at Onset of Present Attack

	Males	Females	Total	
			No.	%
Epigastrium	6	4	10	12.2
Right upper quadrant	16	30	46	56.0
Generalized	3	10	13	15.9
Epigastrium and right upper quadrant	0	4	4	4.9
Right lower quadrant	0	3	3	3.7
Right upper and right lower quadrants	0	1	1	1.2
Indefinite	5	0	5	6.1
	30	52	82	100.0

In one series,[24] the pain of patients suffering with an acute suppurative or gangrenous gallbladder was found to be present in the right upper abdominal quadrant in all instances, a universal finding with which our records do not agree. The pain in that series[24] was referred in about 60 per cent of instances to the back, epigastrium or shoulder.

Abdominal distention was not often noted in our records. Marked tenderness was usually present and fairly well localized to the right upper quadrant. (Table IV.)

A history of chills and fever with the present attack prior to hospitalization was obtained in only nine instances (11.0 per cent). Such a history was obtained by Steinke[22] in 7 per cent of his group of cases with acute cholecystitis. Nausea, vomiting or both were present in most cases. Only five patients each, of our male and female groups, specifically denied experiencing either nausea or vomiting. There was no clinically consistent change in bowel habit. Many patients noted a marked constipation but a large number failed to mention any change while a few had diarrheal stools.

TABLE IV
ADVANCED GALLBLADDER DISEASE
(Acute Suppurative and/or Gangrenous Cholecystitis)

	No. Cases	Per Cent
Tenderness—exquisite	44	53.6
severe	13	15.9
moderate	9	10.9
slight	5	6.1
none	4	4.9
indefinite	7	8.6
Total	82	100.0

Taylor[24] found that 88 per cent of his series with advanced gallbladder disease had experienced either nausea or vomiting. Nausea was noted in 91 per cent and vomiting in 83 per cent of their patients of acute cholecystitis by Fallis and McClure.[9]

Jaundice was found clinically in 10 per cent of the patients during the present attack. There was a history of previous jaundice in only 6 per cent of all patients; many of these had no jaundice during the present attack. A twenty to twenty-five per cent incidence of clinical jaundice was found in Taylor's[24] patients and also in those of Fallis and McClure.[9]

Signs. On admission to the hospital, palpation of the gallbladder was attempted in almost all instances. An enlarged mass in the right upper quadrant was definitely palpated in thirty-eight patients (46.3 per cent), definitely not palpated in thirty-five cases (42.7 per cent). The findings in the

remaining nine were doubtful. Such a mass was found preoperatively in several published series in about 20 per cent of the patients.[9,16]

The preoperative temperature during hospitalization was usually of the sustained type rather than a septic one, with a peak temperature in some cases up to 103°F. while in others it barely exceeded a normal 98.6°F. Most patients, however, ran a moderate fever, the average peak temperature being 101°F. The pulse rate was for the most part increased in proportion to the temperature. An average maximum temperature of 100°F. preoperatively was noted by Taylor[24] in his comparable group.

The average blood pressure reading on admission to the hospital was 134/79 for the men and 144/80 for the women. The readings varied widely between patients as might be expected in any group whose average age was over fifty years.

Table V
ADVANCED GALLBLADDER DISEASE
(Acute Suppurative and/or Gangrenous Cholecystitis)
White Cell Count on Admission to Hospital

White Cells per cu. mm.	Males	Females	All Patients	
			No. Cases	Per Cent
6–10 M	4	11	15	18.5
10–15 M	12	14	26	32.1
15–20 M	10	16	26	32.1
20–25 M	0	6	6	7.4
over 25 M	3	5	8	9.9
	29*	52	81*	100.0

*Data lacking for one patient.

Laboratory Findings. A peripheral blood cell count was done on most patients shortly after admission with repeat counts thereafter. The average white cell count on admission was 15,660 cells per cu. mm. for males and 15,870 cells per cu. mm. for females. The average figures for neutrophils was 81.3 per cent and 80.2 per cent, respectively. In similar reported groups combining both sexes, the average count was 17,122 cells per cu. mm.,[22] and 16,700 cells per cu. mm.[24] The neutrophil percentage was approximately 81 per cent.[24]

In a great many of our patients, the white cell count tended to fall prior to surgical interference. The average white cell count performed a day or so before operation was 14,060 cells per cu. mm. with 80.9 per cent neutrophils for the males and 13,950 cells per cu. mm. with 76.3 per cent neutrophils for the females. Since all of these patients had progressive and probably non-resolving lesions, it is obvious that the fall in blood count was not necessarily indicative of pathological improvement. This fall in count has already been noted.[24]

With the exception perhaps of some concentration due to dehydration, the red cell count was quite normal in most instances. The average count was 4,660,000 cells per cu. mm. with 87.4 per cent hemoglobin for the male group and 4,316,000 cells per cu. mm. with 81.4 per cent hemoglobin for the female group. (The hemoglobin standard used was 13.8 Gm. equals 100 per cent.)

In addition to thirteen patients with known diabetes mellitus, fifty-one patients in our series had fasting blood sugar determinations. Levels of less than 100 mg. per cent were obtained in twenty instances, 39 per cent of the non-diabetic group. Readings of 100 mg. per cent to 120 mg. per cent were obtained in nineteen patients, 37 per cent of the non-diabetic group. The remaining twelve non-diabetic patients showed blood sugar levels in excess of 120 mg. per cent, only four of them over 150 mg. per cent. The elevated blood sugar levels in these cases were probably caused by such factors as concomitant coronary occlusion, intravenous glucose therapy shortly before the test, and perhaps one or two cases of unrecognized diabetes mellitus. Certainly there was nothing to suggest any tendency to produce an elevated fasting blood sugar level such as is known to occur in acute coronary occlusion.

A blood urea nitrogen determination was made in sixty-three cases and this likewise was within normal limits in most patients, 20 mg. per cent or less in forty-nine cases (78 per cent of the tested patients). Elevations not exceeding 35 mg. per cent, (a level easily reached with dehydration) were shown by twelve patients. In the remaining two cases, instances one each of acute coronary occlusion and bronchopneumonia, the figure was in excess of 35 mg. per cent.

ADVANCED GALLBLADDER DISEASE—PERFORATED

An attempt to correlate severity of disease with clinical and laboratory findings was considered advisable, and for this purpose, the records of perforated gallbladders were studied separately.

There were twenty-one such cases (25 per cent of the entire group), nine males and twelve females. These were not necessarily all of recent origin, some of them being well encapsulated by adhesions and omentum while only three were associated with widespread peritonitis. Rupture into the duodenum occurred in one instance; there was no penetration of any other abdominal viscus.

The average age was 61.8 years for the men and 57.1 years for the women, representing an older segment of the original group.

In Taylor's series,[24] rupture of the gallbladder was found in fifteen patients (11.6 per cent of all his cases of acute cholecystitis). The process was diffuse in four instances. Judd and Phillips[15] found sixty-one patients with a perforated gallbladder in their group of 508 cases of acute cholecystitis, of whom three showed generalized peritonitis; forty-three were females and eighteen males. The majority of the perforated patients were fifty years old or over. Perforation into an adjacent viscus occurred in seven patients.

Of the eighty-four cases of gangrene of the gallbladder described by Glenn and Moore,[10] twenty-two showed perforation with a localized abscess while three other patients had a free perforation with generalized peritonitis. The average age for the perforated group was about fifty years while that for the non-perforated group was only forty-four years.

A group of twenty-five cases with gallbladder perforation was reported by Cowley and Harkins[5] of whom sixteen (64 per cent) were women and the other nine (36 per cent) men. More than 60 per cent of the patients were over fifty years. Of the forty-six patients also with perforation of the gallbladder described by Sanders,[20] twenty-two were women with an average age of fifty years and twenty-four men with an average age of fifty-five years. Stone and Douglass[23] presented seventeen such patients whose average age was fifty-two years, ten of them women. The twenty cases of Schaeffer[21] had an average age of fifty-nine years. Atlee and Atlee[1] reported sixteen patients with gallbladder perforation who had an average age of fifty-seven years and whose numbers were divided equally between the sexes. A free perforation was found in four instances and one patient had developed a duodenal fistula.

Edwards, Gerwig and Guyton[7] reported on 194 cases of acute cholecystitis of whom twenty-one were instances of perforation (10.8 per cent). Approximately this incidence has been reported by many other observers.[2] Review of the literature by Cowley and Harkins[5] showed 13 per cent to be perforated.

Our patients with perforation of the gallbladder gave a history of antecedent gallbladder disease varying from a short interval in some patients to a very long one in others, occasionally fifteen to twenty years. In only three cases did the patient deny any prior biliary dysfunction. All of the sixty-one perforated patients reported by Judd and Phillips[15] had had earlier symptoms referable to the biliary tract and forty-eight of them had had previous acute symptomatology. Prior symptoms were acknowledged by thirty-seven of the forty-six patients presented

by Sanders.[20] The incidence was 90 per cent in the group of Cowley and Harkins[5] while Atlee and Atlee's[1] patients all had attacks previously.

The average duration of the acute recent attack until its termination by either operation or demise was eleven days for our female patients and eight days for the male, a shorter interval than for the general group. Apparently the acuteness of the average perforated case was noted and an earlier interference practiced. In eight instances surgery was performed within seven days of the acute onset, five of these within three days. This checks closely with the average figure of 9.6 days noted by Taylor.[24]

A mass in the region of the gallbladder was definitely palpated in about one-third of the perforated patients which was also the finding of Judd and Phillips[15] and Sanders.[20] Cowley and Harkins[5] noted such a mass in 24 per cent of their cases.

The pain was as diversified in onset as in the general group. However, it seemed to be more widespread, fully 50 per cent of patients having pain across the entire upper abdomen from the very onset. The pain and tenderness found was more severe and more often present than in the general group, fully two-thirds of the patients showing extreme tenderness and abdominal rigidity. It is interesting to note that among the remaining one-third of the patients were some in whom the perforation was apparently of long duration and in whom a state of localized chronic abscess formation had occurred. These patients showed very little tenderness or rigidity. Virtually all of the patients with an acute perforation experienced both nausea and vomiting.

In the perforated group, the average count on admission was 16,600 white blood cells per cu. mm. with 82 per cent neutrophils. Three cases had counts in excess of 26,000 cells per cu. mm. Of sixty-one patients with perforated gallbladders reported by Judd and Phillips,[15] twenty-five showed a white cell count in excess of 10,000 cells per cu. mm. and in seven of these it was over 20,000 cells per cu. mm. In a similar series of twenty-one patients, Edwards, Gerwig and Guyton[7] found the count to be from 18,000 to 20,000 white cells per cu. mm. The patients of Stone and Douglass[23] had an average count of 14,000 white cells per cu. mm.

Surgery. Surgery of the gallbladder was performed in seventy-three cases, 89 per cent of our entire series of patients with advanced gallbladder disease. The type of operation performed varied from a simple incision and drainage of the gallbladder to complete excision, the more serious cases receiving the most simplified surgery. Complete cholecystectomy was done in approximately one-half of the operative cases both of men and women.

Table VI
TYPES OF ANESTHESIA USED

	Spinal	Ether	Local	$N_2O + O_2$	None (no op.)	Total
Ac. sup. and/or gang. cholecystitis	59	2	9	3	9	82
No. died	7	1	1	2	9	20
Per cent	11.9	50.0	11.1	66.7	100.0	
Rupt. cholecystitis only.	14	0	3	0	4	21
No. died	3	0	0	0	4	7

In the perforated group, complete cholecystectomy was performed in only three instances while fourteen other patients were treated with simple incision and drainage.

The anesthesia of popular choice was spinal, which was used in fifty-nine (81 per cent) of the seventy-three operative cases. Supplementary anesthesia was necessary in seven instances, the methods used being inhalation nitrous oxide-oxygen, ether or intravenous pentothal sodium. Nine patients had their operation under local and the remaining five cases were done under either ether or nitrous oxide-oxygen supplemented with ether.

In the perforated group, fourteen patients had spinal anesthesia and the remaining three patients received local.

Cholelithiasis. Most of the gallbladders were examined carefully for stones. This examination was of necessity not very carefully performed in some operative cases in which a cholecystostomy was necessary. Stones were definitely found in sixty-five patients, 79 per cent of the eighty-two in our series. In eleven of the remaining patients, minimal exploratory surgery made it impossible to ascertain the presence or absence of stones; in six instances, 7.3 per cent of the entire series, (some at postmortem), ample opportunity for examination was available and a careful search failed to reveal any evidence of stones.

Gallstones were found in two-thirds of the patients in the perforated group. In only one patient was no such finding present even though a careful search was possible and was made.

TABLE VII
ADVANCED GALLBLADDER DISEASE
(Acute Suppurative and/or Gangrenous Cholecystitis)

	Males		Females	
	No. Cases	Per Cent	No. Cases	Per Cent
Gallbladder stones				
Present	24	80.0	41	78.8
Not present	3	10.0	3	5.8
Doubtful	3	10.0	8	15.4
Total	30	100.0	52	100.0

Steinke[22] found stones present in 77 per cent of his thirty patients with advanced gallbladder disease. Taylor[24] noted stones in 94 per cent of all his cases of acute cholecystitis. He found no difference between the frequency with which stones were present and the degree of the pathological condition. A similar incidence of stones was noted by Schaeffer.[21] In the eighty-four cases with gangrene of the gallbladder described by Glenn and Moore,[10] five of the forty men had no stones but in all of the forty-four women, stones were found. Judd and Phillips[15] found gallstones in 92 per cent of their perforated patients. Stones were present in forty-two of the forty-six cases reported by Sanders[20] and in 92 per cent of those described by Cowley and Harkins.[5]

Mortality. In the complete group of eighty-two cases, twenty died during their hospital stay (almost 25 per cent). Of the seventy-three operative patients, eleven died postoperatively for a gross surgical mortality of 15.1 per cent.

The records of all the deceased patients were checked and the cause of death determined as accurately as possible. Patients were then classified into the following etiological groups: (I) Death as a direct result of biliary tract disease; (II) death as a result of disease aggravated by the biliary disease, and (III) death as the result of disease apparently unrelated to biliary disease and uninfluenced by it.

There were twelve patients in the first category, four patients in the second and four in the third. In the last named group, empyema of the gallbladder was an incidental finding at postmortem.

Despite the lessened trauma attending gallbladder incision in contrast to excision, the mortality was much greater (over twice as much) in the group of patients treated by cholecystostomy. It must be remembered, however, that the people cared for in this manner were, for the most part, the poorest risks.

The average age of the group that died was 60.5 years, an average definitely higher than that for the non-fatal cases. This is not surprising considering the relative frequency with which the severer forms of cholecystitis are found in older people.

The average interval between the onset of the most recent acute attack and its termination either by operation or the prior demise of the patient was 10.5 days. This is greater than the comparative figure for the non-fatal group, partly due to the poor condition of some of the patients with severe concomitant disease forbidding early

interference. The white cell count averaged 16,300 cells per cu. mm.; 81.8 per cent of the cells were polymorphonuclear cells.

diabetic patients in the present series. The significance of this will be discussed later.

TABLE VIII
OPERATIVE MORTALITY

	Ac. Sup. and/or Gang. Cholecystitis				Rupt. Cholecystitis Only			
	No. Cases	Per Cent	Deaths	Per Cent	No. Cases	Per Cent	Deaths	Per Cent
Cholecystostomy	40	54.8	8	20.0	14	82.3	3	21.4
Cholecystectomy	33	45.2	3	9.1	3	17.7	0	0.0
Total oper. pts.	73	100.0	11	15.1	17	100.0	3	17.7
No operation	9		9		4		4	
Total	82		20		21		7	

Judd and Phillips[15] had six deaths in their series of sixty-one patients operated upon for acute perforated cholecystitis; five deaths followed cholecystectomy performed on forty-eight patients and one death followed cholecystostomy on thirteen patients. In the twenty-one perforated cases described by Edwards et al,[7] three were moribund on admission and died without the benefit of surgery. Of the other eighteen patients, three died postoperatively, making an overall mortality of 29 per cent and a gross surgical mortality of 17 per cent. The best results were those of Eliason and Stevens[8] who performed a cholecystostomy of seventeen patients with gallbladder perforation without any deaths.

Diabetes Mellitus. There were thirteen diabetic patients in our entire series. Several years ago, a check of 1,500 consecutive medical deaths that occurred in this hospital showed that diabetic patients constituted 7.7 per cent of the total.[27] In another study conducted here, it was also found that diabetic individuals had over twice the tendency to develop cholelithiasis as had other patients, making diabetics about 16 per cent of all the cases showing gallstones.[4] This is almost the same as the figure of 15.9 per cent, the percentage of

Our diabetic series of gallbladder patients consisted of five males and eight females with an average age of 61.4 years. The relative sex incidence was, therefore, the same as for all other cases of advanced gallbladder disease though the average age was increased. About half of the patients were operated upon within a week of onset of their most recent attack. An enlarged gallbladder was palpated preoperatively in nine cases, not palpated in the remaining four patients. The average white cell count on admission was 15,200 per cu. mm. with 81 per cent neutrophils, averages almost identical with those for the general non-diabetic group. There were three perforated cases among the thirteen diabetic patients making an incidence of 23 per cent, another point of similarity between the two series, diabetic and non-diabetic.

Of the thirteen patients in our diabetic group, eleven (85 per cent) came to operation. There were two cholecystostomies performed under local anesthesia, six cholecystostomies and three cholecystectomies under spinal anesthesia. Gallstones were found in ten instances, 77 per cent of the diabetic patients.

The mortality for patients with diabetes was very high, seven (54 per cent) dead in

a group of thirteen patients. Considered from another angle, the seven diabetic deaths constituted 35 per cent of the total mortality though the diabetic patients were only 15.9 per cent of the entire series. Furthermore the diabetic deaths were all in Class I or II, deaths due directly or indirectly to the biliary condition. If the four cases of Class III non-diabetic deaths are omitted from consideration, then diabetic fatalities totaled 44 per cent of all the deaths for which gallbladder disease either was responsible directly, or was an important contributory factor, nearly three times the anticipated incidence.

TABLE IX

MALE DEATHS

Pts. Initials	Age	W.B.C. on Admission: Cells/cu. mm.	W.B.C. on Admission: % Neut.	Duration of Recent Attack (Days)	Peak Precop. Temp. (Fahren.)	Primary Final Diagnosis	Contributory Diagnosis	GB Stones Present	GB Ruptured	Diabetic	Operation	Anesthesia	Type of Operation	Class (See Text)	Total Duration GB Symptoms
N.R.	46	12,400	76	8	103	1. Diffuse Peritonitis 2. Ac. Empyema GB	.....	no	yes	no	no	.....	.....	1	5 years
F.C.	69	.....	..	..	.....	Ac. Ant. Coronary Occ.	Chr. Empyema GB	no	yes	no	no	.....	.....	3	indefinite
P.S.	70	12,000	70	..	.....	Cancer of Sigmoid	Chr. Empyema GB	yes	yes	no	no	.....	.....	3	
A.S.	68	25,400	85	7	102	1. Ac. Empyema GB 2. Ac. Sup. Pancreatitis	.....	yes	no	yes	no	.....	.....	1	3 years
W.S.	45	25,000	91	4	103.6	1. Bilat. Bronchopneum. 2. Ac. Empyema Thoracis	Ac. Empyema GB	yes	no	yes	no	.....	.....	2	
J.G.	68	8,500	56	..	98.6	1. Bilat. Bronchopneum. 2. Ac. Empyema Thoracis	1. Chr. Empyema GB 2. Ununited Frac. Femur	yes	no	no	no	.....	.....	3	
I.S.	43	9,700	72	..	98.0	Ac. Empyema GB	Ac Toxic Hepatitis	yes	no	no	yes	N_2O	-ectomy	1	2 years
P.M.	51	20,500	82	9	100.4	Bilat. Bronchopneum.	Ac Empyema GB	yes	no	no	yes	N_2O	-ectomy	2	indefinite
L.F.	66	14,000	88	9	103	Bilat. Bronchopneum.	Ac Empyema GB	?	no	yes	yes	spinal	-ostomy	2	indefinite
M.S.	64	20,000	91	11	.....	1. Ac. Empyema GB 2. Sec. Liver Abscesses	.....	yes	yes	yes	yes	spinal	-ostomy	1	7 wks.
C.B.	61	8,500	78	2	101	1. Diffuse Peritonitis 2. Ac. Empyema GB	.....	yes	yes	no	yes	spinal	-ostomy	1	20 years

Diabetic patients fared poorly in the series of 337 gallbladder operations reported by Russo[19] in which diabetics constituted 11 per cent of the deaths and 2.6 per cent of the living group. The end results reported by McKittrick and Root[17] in gallbladder surgery on twenty-four diabetic patients was remarkably good in that there were no deaths. They described seventeen cholecystectomies and two cholecystostomies in cases of simple cholelithiasis, and four cholecystectomies and one cholecystostomy in cases of suppurative or gangrenous disease of the gallbladder, all in diabetics.

COMMENTS

The fact that gallstones are found in cases of acute cholecystitis in a far greater incidence than that due to chance alone, suggests either a common etiology or else that the stones play some rôle in the acute process. Very commonly, stones are found wedged into the cystic duct causing local edema. Such a condition can, by interfering with blood supply, cause the pathologic processes known as acute cholecystitis. In a minority of cases, other obstructing factors such as anomalies, extrinsic pressure, etc., may produce the same condition. Experimental work tends to confirm these views.

Most patients have been suffering more or less from chronic gallbladder disease, usually cholelithiasis, before they develop acute and dangerous conditions. Rather than argue over the relative merits of early or delayed surgery in acute cholecystitis, it might be wiser to consider carefully the prophylactic approach to the problem, i.e., the desirability of removing the gallbladder in all symptomatic cases of chronic cholelithiasis as a curative for symptoms and as a preventitive for complications. Such a policy must be carefully evaluated in terms of morbidity and mortality which is beyond the scope of this paper. Certainly every case of acute cholecystitis that is allowed to subside should come to surgery after a reasonable interval, to preclude future more serious attacks which commonly occur.

It is interesting to note that if cases of acute cholecystitis are classed in groups in the order of increasing severity of disease, the average age increases for each group. Since antecedent gallbladder disease is usually present, this may indicate that severity of gallbladder disease is a direct function of chronicity of gallbladder conditions. Then again, the diminution of vascularity with increasing age and the fibrosis accompanying frequent attacks may favor widespread and serious damage with sudden vascular obstruction.

If one considers groups of patients, it is noticeable that the severity of the signs, symptoms and the degree of leucocytosis varies directly with the extent of the pathologic process. It is well recognized, however, that there are no pathognomonic findings for advancing gallbladder disease and that group averages must not be applied too strictly to individual cases. In fact, for any given patient it is not possible to correlate severity of signs and symptoms with the degree of disease present.[10,13,24]

Since cholelithiasis seems to be present in 80 to 90 per cent of all cases of acute

TABLE X

FEMALE DEATHS

Pts. Initials	Age	W.B.C. on Admission		Duration of Recent Attack (Days)	Peak Preop. Temp. (Fahren).	Primary Final Diagnosis	Contributory Diagnosis	GB Stones Present	GB Ruptured	Diabetic	Operation	Anesthesia	Type of Operation	Class (See Text)	Total Duration GB Symptoms
		Cells/cu. mm.	% Neut.												
J.M.	65	12,500	76	9	103	1. Ac. Empyema GB 2. Ac. Sup. Cholangitis	.....	yes	no	yes	yes	local	-ostomy	1	20 years
B.M.	58	13,000	98	15	101	Arteriosclerotic Heart Disease	Ac. Empyema GB	yes	no	no	yes	spinal	-ectomy	2	3 years
R.B.	62	11,000	75	52	103.8	1. Ac. Empyema GB 2. Ac. Sup. Hepatitis	.....	yes	no	yes	yes	spinal	-ostomy	1	
S.B.	55	18,500	92	19	104	Ac. Empyema GB	Arteriosclerotic Heart Disease	?	no	no	no	.....	.....	1	Indefinite
S.R.	73	14,500	87	5	101	Ac. Empyema GB	Fatty Degeneration Liver and Heart	yes	no	no	yes	spinal	-ostomy	1	
E.M.	67	32,500	96	32	103	1. Ac. Empyema GB 2 Ac. Sup. Hepatitis	.....	yes	no	no	no	.....	.....	1	1 month
M.M.	63	21,000	89	2	100	Ac. Ant. Coronary Occlusion	Ac. Empyema GB	yes	no	no	yes	ether	-ostomy	3	2 days
F.H.	61	27,000	87	24	102	1. Diffuse Peritonitis 2. Duodenal Fistula 3. Ac. Empyema GB	Subac. Bact. Endocarditis	yes	yes	no	no	.....	.....	1	2 years
S.A.	56	12,900	75	3	.....	1. Ac. Empyema GB 2. Gang. Abdom. Wound	.....	?	yes	yes	yes	spinal	-ostomy	1	3 days

cholecystitis, a breakdown in the incidence of the one should approximately parallel a similar breakdown in the incidence of the latter. For example, the finding of stones in one and one-half times as many women as men was paralleled by a similar ratio in the cases of advanced gallbladder disease. In the diabetic group, a similar situation apparently exists for these patients totaled approximately 16 per cent both of the group with cholelithiasis and those with advanced gallbladder disease. This would tend to suggest that although diabetes mellitus is accompanied by a marked tendency for gallstone formation, there is no unusual tendency for these diseased gallbladders to progress to suppuration or gangrene. The exceptionally high mortality in these diabetic patients, however, suggests that they tolerate tissue destruction in the gallbladder as poorly as they do elsewhere. Diabetic patients, therefore, should not only be considered poorer risks for surgery in advanced gallbladder disease, but probably deserve more prophylactic surgery. The prophylactic cholecystectomy in diabetic patients with cholelithiasis is hardly a radical suggestion, appearing as it does in Joslin's popular text.[14] Rabinowitch[18] likewise urged gallbladder removal in these patients though he, like Joslin, was primarily concerned with the beneficial effects on the diabetic status.

SUMMARY

A series of eighty-two cases of empyema and/or gangrene of the gallbladder were reviewed from the standpoint of incidence, symptoms, signs and laboratory findings. The perforated cases were reviewed separately in a similar manner and comparisons made. No consistent significant differences were found other than an intensification of signs and symptoms. All the cases were also considered and discussed from the standpoint of surgery, gallstones and mortality.

The thirteen cases of diabetes mellitus were then analyzed separately. The mortality of these patients was found to be much higher than that for the non-diabetic patients.

REFERENCES

1. Atlee, J. L. and Atlee, J. L., Jr. Acute cholecystitis. *Pennsylvania M. J.*, 44: 731–734, 1941.
2. Berk, J. E. Management of acute cholecystitis. *Am. J. Digest. Dis.*, 7: 325–332, 1940.
3. Best, R. R. The acute gallbladder. *Surg., Gynec. & Obst.*, 73: 312–319, 1941.
4. Blumberg, N. and Zisserman, L. Cholelithiasis. *Rev. Gastroenterol.*, 9: 318–320, 1942.
5. Cowley, L. L. and Harkins, H. N. Perforation of gallbladder. *Surg., Gynec. & Obst.*, 77: 661–668, 1943.
6. Deaver, J. M. Abstract of Discussion.[1]
7. Edwards, C. R., Gerwig, W. H. and Guyton, W. L. Acute cholecystitis with perforation into the peritoneal cavity. *Ann. Surg.*, 113: 824–832, 1941.
8. Eliason, E. L. and Stevens, L. W. Acute cholecystitis. *Surg., Gynec. & Obst.*, 78: 98–103, 1944.
9. Fallis, L. S. and McClure, R. D. Acute cholecystitis. *Surg., Gynec. & Obstr.*, 70: 1022–1028, 1940.
10. Glenn, F. and Moore, S. W. Gangrene and perforation of wall—sequel of acute cholecystic disease. *Arch. Surg.*, 44: 677–686, 1942.
11. Graham, H. F. Acute cholecystitis. *Surg., Gynec. & Obst.*, 77: 674–676, 1943.
12. Graham, H. F. Value of early operation for acute cholecystitis. *Ann. Surg.*, 93: 1152–1155, 1931.
13. Hicken, N. F. and Coray, Q. B. Perforating gallbladder. *Rocky Mountain M. J.*, 40: 524–529, 1943.
14. Joslin, E. P. Treatment of Diabetes Mellitus. 6th ed. Philadelphia, 1937. Lea & Febiger.
15. Judd, E. S. and Phillips, J. R. Perforation of the gallbladder in acute cholecystitis. *Ann. Surg.*, 98: 359–361, 1933.
16. Judd, E. S. and Phillips, J. R. Acute cholecystic disease. *Ann. Surg.*, 98: 771–799, 1933.
17. McKittrick, L. S. and Root, H. F. Diabetic Surgery. P. 235. Philadelphia, 1928. Lea & Febiger.
18. Rabinowitch, I. M. Surgical treatment of chronic gallbladder disease in diabetes mellitus. *Ann. Surg.*, 96: 70–74, 1932.
19. Russo, C. Five years of gallbladder surgery in a general hospital. *Am. J. Surg.*, 58: 388–397, 1942.
20. Sanders, R. L. Perforation of gallbladder. *Surgery*, 1: 949–958, 1937.
21. Schaeffer, R. L. Acute and chronic perforation of gallbladder. *Pennsylvania M. J.*, 45: 566–569, 1942.
22. Steinke, C. R. Acute gallbladder disease. *Am. J. Surg.*, 27: 135–138, 1935.
23. Stone, W. W. and Douglass, F. M. Perforation of gallbladder. *Am. J. Surg.*, 45: 301–303, 1939.
24. Taylor, F. The acute gallbladder. *Surg., Gynec. & Obst.*, 63: 298–307, 1936.
25. Womrack, N. A. and Bricker, E. M. Pathogenesis of acute cholecystitis. *Arch. Surg.*, 44: 658–676, 1942.
26. Zinninger, M. M. Surgical treatment of acute cholecystitis. *Ann. Surg.*, 96: 406–412, 1932.
27. Zisserman, L. Unpublished data.

METATARSAL MARCH (FATIGUE) FRACTURES*

ALBERT L. LEVETON, M.D.
In the Department of Orthopedics, University of Iowa
IOWA CITY, IOWA

MARCH or "fatigue" fracture is an occupational disease associated with military training. Although Meyerding and Pollock in 1938 described ten cases in civilians, seven of whom were women, and Zeitlin and Odessky, and Harmon have reported sporadic cases, the condition is extremely rare in civilian practice.

This paper deals with 259 cases of march fracture of the metatarsals, of which twenty-three were multiple, observed at a Station Hospital.

HISTORY

In 1855, Breithaupt, a Prussian military surgeon, was the first to associate injury of the foot with the trauma of marching. He called it swollen foot. Various other authors, namely, Weisbach and Pauzat in 1877 and Martin in 1891 described a similar condition of the foot following marching. It was left to Stechow in 1897, following the advent of roentgenography, to demonstrate that the foot complaint described by earlier observers was due to a fracture of a metatarsal bone. This was confirmed by Schulte.

Since the first description of this condition by Breithaupt a voluminous literature has arisen. Strangely enough, although European literature was replete with references to this condition, American literature was particularly barren until the advent of World War II. Goldman, however, in 1928 was the first to describe this condition accurately in American literature. With the outbreak of present hostilities, contributions to American literature have been made by Sirbu and Palmer, Henchell, Bosshardt, Meyerding and Pollock, Krause and Bowen, etc.

ETIOLOGY

Numerous theories as to the mechanism of march fractures have been advanced by various authors, almost as many theories as authors who have written on the subject. Breithaupt, in 1855, attributed the disease to a traumatic tenosynovitis. Weisback, in 1877, believed it was due to a tendonitis. Pauzat, in 1877, held that the government issued shoes of the French army, which had a dorsal fold, was a contributing factor. Martin, in 1891, thought the condition was due to a synovitis. Stechow, in 1897, demonstrated a metatarsal fracture. He and Kirschner attributed the condition to abnormal stresses and strains causing periosteal reaction and callus formation. In 1921, Deutchlaender concluded that the condition was due to a hematogenous bacterial periostitis with callus formation. In 1926, Murk Jansen believed that march fractures were due to an ischemic phenomenon resulting from spasm of the interossei leading to vascular obstruction and edema of the periosteum and soft tissues. This in turn caused decalcification of the defective bone rendering it liable to fracture and was followed by secondary deposit of new bone in the same area. McMurray, in 1937, believed the disorder was due to metatarsalgia, i.e., a flattened short tarsal arch. Krause, in 1942, believed that prolonged and repeated foot strain resulted in rhythmically repeated subthreshold mechanical insults acting by summation to a point beyond the capacity of the bone to bear

* The data offered in this paper represent the author's military experience when on active duty with the Medical Corps.

the stress. Morton, in 1927, 1928, 1930, and 1935, Dodd, in 1933, Sirbu and Palmer, in 1942, Geoffrey Flavell, in 1943, stressed the anomalous development of the foot

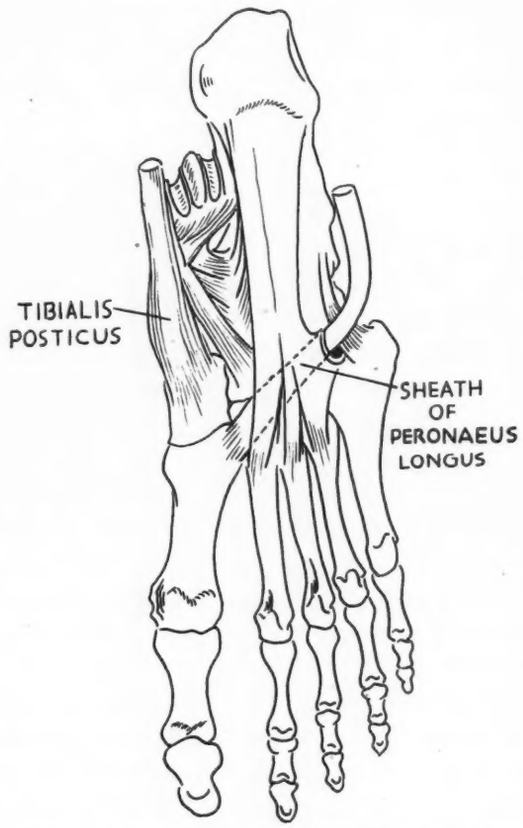


Fig. 1. Anatomy of foot, demonstrating the "sling" formed by tibialis posticus and peronaeus longus tendons.

as a predisposing cause resulting in a shift of weight from the first to the second or third metatarsal bone which were unsuited to bear the load.

Because such great importance in recent literature has been placed upon the anomalous foot as a contributing factor of march fractures of the metatarsals it might be well to examine a series of cases in the light of the so-called atavistic or Morton's foot. It is the belief of the author that the most important factor in the incidence of metatarsal march fractures is fatigue of the peroneus longus and tibilias posticus muscles rather than the length and disposition of the metatarsal bones. The tibilias posticus tendon sweeps around the medial aspect of the foot and is inserted on the plantar aspect of the navicular, first, second, and third cuneiform bones with slips passing to the sustentaculum tali and cuboid. The peroneus longus tendon passes from the lateral aspect of the foot along the plantar surface and is inserted into the base of the first metatarsal and second cuneiform bones. Thus these two tendons form a sling which assists in the support of the long plantar arch. (Fig. 1.) Notwithstanding the belief of Sirbu and Palmer, who state that march fracture "occurs in young soldiers unused to rigors of long marches but only in those whose feet are inherently weak or flat," the author finds that of 259 metatarsal march fractures, in 105 cases in which the condition of the foot was noted, fifty-nine patients had normal feet, fifteen had pes planus one degree, fourteen had pes planus two degrees, and seventeen had pes cavus. It is obvious from these figures that metatarsal march fractures occurred chiefly in soldiers with normal feet, or in soldiers with slight degree of pes planus or in those with pes cavus. No case of march fracture was found associated with marked degrees of pes planus. This is in keeping with the contention of the author that the normal foot depends upon the tibialis posticus and peroneus longus for support, but due to the fatigue of these muscles the metatarsals are compelled to take the full weight of a man's body and his field pack. Conversely in marked degrees of pes planus the metatarsals are conditioned to direct weight bearing and they can get along without the support of these two tendons and so are not subject to fracture as frequently.

Bruce states that the normal metatarsal segment is one in which the five metatarsal bones are arranged in parallel formation with the head of the first metatarsal on the same transverse plane or even a little more distal than that of the second. All deviations from this are atavistic. In the ideal foot the first metatarsal is completely adducted and equals in length the longest of the digital segment. It undergoes

hypertrophy and has the stoutest of the five shafts. The other metatarsals decrease in length and their shafts become almost parallel.

metatarsal, and in twenty-two cases the first metatarsal was longer than the second. When comparing the length of the first metatarsal with the third metatarsal in

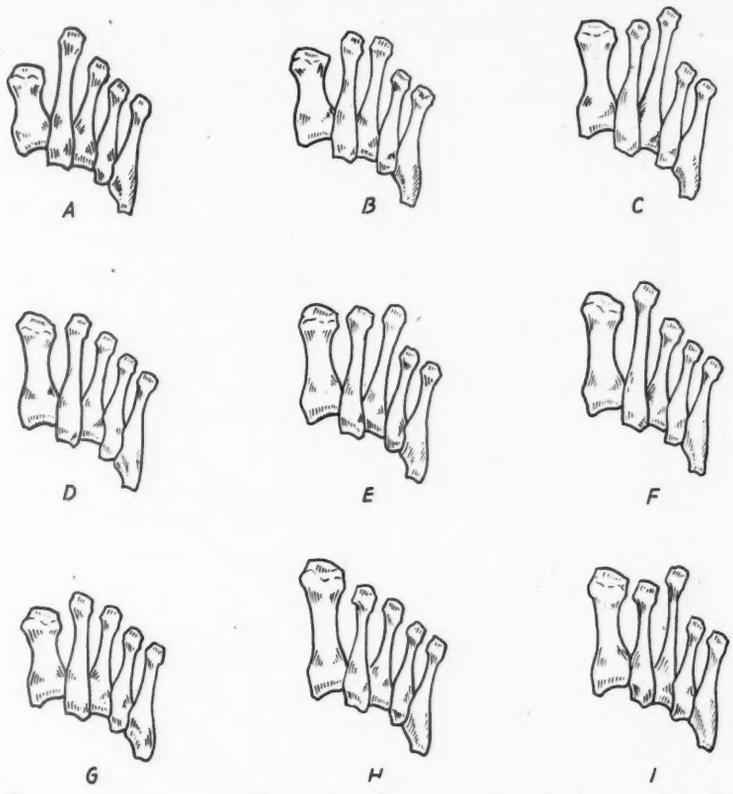


FIG. 2. Arrangement of metatarsal segment in relation to site of fracture.

NO. OF TIMES FRACTURED, METATARSALS

	First	Second	Third	Fourth	Fifth
A	3	21	38	6	3
B	..	1	1		
C	..	2	..	..	3
D	1	18	22	3	1
E	..	9	7	1	
F	..	2	5		
G	1	25	59	7	
H	..	9	9	1	
I	..	..	..	..	1

Flavell claims that any of the extremely common atavisms cause a shift of stress to the second and third metatarsals and are contributory factors in the etiology of metatarsal march fractures. However, in 259 cases, 171 first metatarsals were shorter than the second, sixty-six first metatarsals were equal to the second

259 cases, seventy-six first metatarsals were shorter, 114 were equal, and sixty-nine were longer than the third metatarsals. In 259 cases, the longest bone of the metatarsal segment was fractured in seventy-seven cases, and in 174 cases, the fracture involved a metatarsal which was shorter than one or more of its fellows; in

eight cases, another metatarsal was equal in length to the fractured metatarsal. In fractures of the first, fourth, and fifth metatarsals comprising thirty-one cases one or more metatarsals were longer than the fractured bone. In the case of eighty-seven fractures of the second metatarsal, the second was the longest segment in forty-eight cases, was shorter in eleven cases, and was equal in length in twenty-eight cases. In 141 fractures of the third metatarsal, the third was shorter in 133 cases than another component of the metatarsal segment, was equal in eight cases, and in no case was longer than one or more of its fellows. It appears from this that if the second metatarsal is longer and protrudes beyond the other segments it is apt to be the site of fracture. In the case of the third metatarsal, the commonest site of march fractures, in not one case did the involved third metatarsal project beyond, and in only eight cases did it equal one of its fellows in length. Hence the atavistic foot does not appear to be an important predisposing cause of fracture. (Fig. 2.)

Fig. 3. Relationship of fracture to thinness of metatarsal bone. A, thinnest metatarsal, ninety-six cases; B, other than thinnest metatarsal, 163 cases.

It might appear that the thinnest metatarsal would be subject to fracture most often. However, in 259 cases, the thinnest metatarsal was involved in ninety-six cases, and in 163 cases, a metatarsal other than the thinnest was fractured. (Fig. 3.)

Does a man's pre-induction occupation play a part in etiology? I do not believe that it does. In 121 cases, in which occupation of the trainee was investigated, 53 per cent followed sedentary occupations and 47 per cent an active occupation; however, the rigorous training of military life is such that even the most vigorous civilian occupation is not its equal. A man following an active occupation or participating in an active sport can rest when fatigued, whereas in military training a soldier is expected to continue on his march even if greatly fatigued. The good physical condition of a man entering the army would tend to prevent early fatigue, but a very small percentage of men can stand the rigors of a 25 mile march in eight hours, for example, without a greater or lesser degree of fatigue. It is interesting to note that most of our march fractures of the metatarsals occurred in the second to fourth month of training, when the training program was most strenuous.

INCIDENCE

At a Station Hospital, from September 1, 1943, to May 30, 1944, a period of nine months, 996 orthopedic cases were hospitalized and 9,957 orthopedic cases were seen by our consultation service, a total of 10,953 cases. Metatarsal march fractures comprised 259 cases or 2.35 per cent. The right foot was involved 154 times and the left foot 105 times. (Figs. 4 and 5.) In five march fractures of the first metatarsal, two occurred in the right foot and

three in the left foot; in eighty-seven march fractures of the second metatarsal, fifty-one cases occurred in the right and thirty-six in the left; in 141 third metatarsal, march fractures, eighty-eight occurred in the right and fifty-three in the left foot; in eighteen cases of fourth metatarsal fractures, nine cases occurred in each foot; in eight cases of involvement of the fifth metatarsal, four occurred in each foot.

Twenty-three cases of multiple march fractures were encountered; four cases involved the second metatarsal of each foot; in two cases, the third metatarsal of each foot; in one case, the second and fifth metatarsal of the right foot; in two cases,

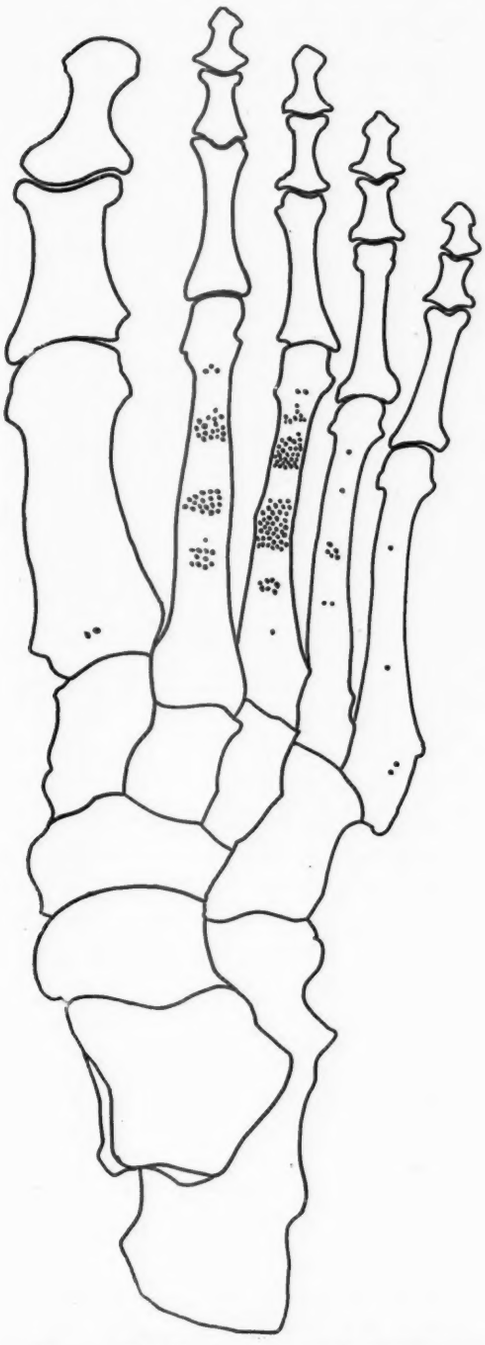


Fig. 4. Distribution of march fracture, right foot.

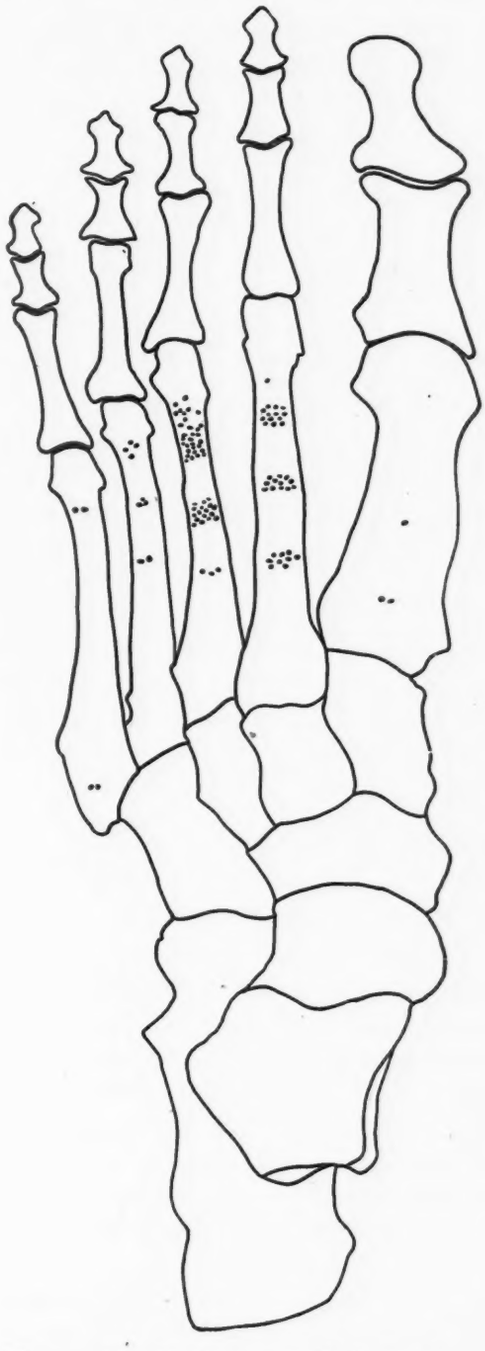


Fig. 5. Distribution of march fracture, left foot.

the second and third metatarsals of the left foot, and in six cases, the second and third metatarsal of the right foot; in three cases, the left second and the right third; one case involved the left first and fourth and right third metatarsal; in one case, left second, third, and fourth metatarsal; the left third and fourth were involved twice and the right third and fourth once. (Fig. 6.)

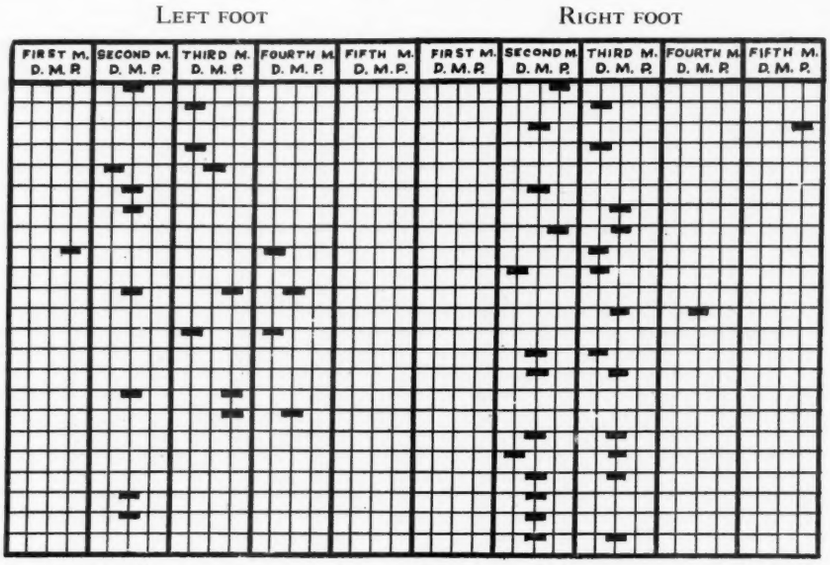

LEFT FOOT
RIGHT FOOT
FIRST M. D. M. P.
SECOND M. D. M. P.
THIRD M. D. M. P.
FOURTH M. D. M. P.
FIFTH M. D. M. P.
FIRST M. D. M. P.
SECOND M. D. M. P.
THIRD M. D. M. P.
FOURTH M. D. M. P.
FIFTH M. D. M. P.

FIG. 6. Distribution of twenty-three multiple march fractures. D, distal third; M, middle third; P, proximal third.

SITE OF FRACTURE

In the first metatarsal, the base was involved four times, the middle third once. There was no displacement of the fragments. Two fractures were complete, three incomplete. In the second metatarsal, thirty-one cases involved the junction of the middle and distal third; twenty involved the junction of the proximal and middle thirds; the neck was involved five times; the middle third was involved thirty times. Eight cases showed angulation of fragments, seventy-nine cases did not. In sixty-six cases fracture was complete and in twenty-one incomplete. In the third metatarsal fifty-one cases involved the junction of the middle and distal thirds; ten cases the proximal and middle thirds; twenty-one cases the neck; and in fifty-nine cases the midshaft. Twenty-one cases showed angulation of fragments, 120 cases did not. In 108 cases the fracture was complete; in thirty-three incomplete. In the fourth metatarsal the junction of the middle and distal thirds was involved four times; the junction of the proximal and middle thirds two cases; the neck five cases; mid-shaft seven cases. Four cases showed angulation, fourteen cases had no displacement. Fracture was complete in fifteen cases, incomplete in three cases. In the fifth metatarsal the junction of the middle and distal thirds was involved in one case; the junction of the proximal and middle thirds one case; the neck two cases; and the base in four cases. Two cases showed angulation, six did not. In all eight cases fracture was complete.

To recapitulate, of 259 cases the fracture was complete in 199 cases and incomplete in sixty cases. (Fig. 7.) Of the same number of cases, in 224, there was no displacement of the fragments and in thirty-five some displacement. (Fig. 8.)

AGE

The highest percentage of fractures occurred in the eighteen and nineteen year old group of trainees. This was due in large

measure to the fact that the greatest number of our trainees were in that age group. (Fig. 9.) Metatarsal march fractures occur

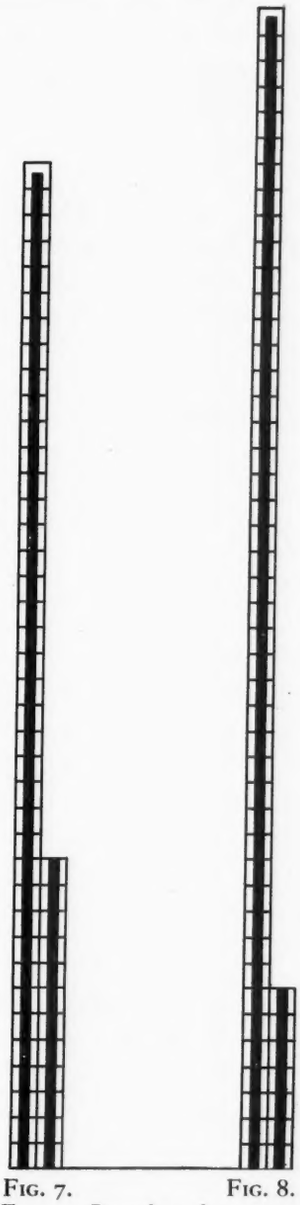


Fig. 7. Fig. 8.

Fig. 7. Complete fractures versus incomplete fractures; 199 complete; sixty incomplete.

Fig. 8. Fractures without displacement versus fractures with displacement; 224 without, thirty-five with displacement.

in all age groups, the oldest being thirty-eight years. It is my belief that age plays no great part in the incidence of march fractures.

CLINICAL COURSE

The patient is usually a trainee about eighteen or nineteen years old with about

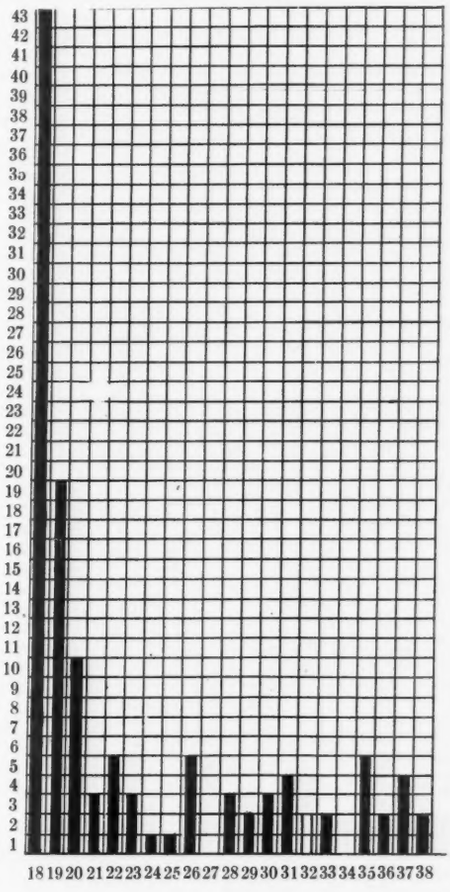


Fig. 9. Age distribution of metatarsal march fractures.

four to twelve weeks service. He complains of pain in the fore part of the foot and generally states that he was on a long or forced march when he experienced pain. This pain is insidious in its onset or came on acutely. It is not usually very severe and the soldier is able to continue with his march. This, of course, varies with the individuals pain threshold level. That evening the soldier may notice slight swelling on the dorsum of the foot. Taking the weight off the foot relieves the pain. In some cases the soldier may not be greatly inconvenienced and he may complete all phases of his seventeen-week training cycle. The longest period of complaint was eighty-four days before march fracture could be demonstrated; the shortest period

was one day before hospital entry. The average length of time from date of injury to hospitalization in 121 cases was 15.4 days.

On physical examination there is slight swelling on the dorsum of the foot. Point tenderness is present over the involved metatarsal. Motion of the toe causes pain. No crepitation is generally elicited.

X-ray may show slight periosteal thickening without fracture, usually in the second and third metatarsal. When fracture involves the first metatarsal it occurs at the base and is of the "ice-crack" type. *X*-ray findings vary with the age of the injury. Early in the first week there may be merely periosteal elevation and thickening. In some cases there is a small crack through the cortex and in others there may be complete fracture. With the history of a long march and pain localized over the metatarsal bones, a negative *x*-ray is not conclusive. A recheck is indicated in about a week. Following the first week there may be diffused thickening of the periosteum without obvious fracture, or as is more common, the fracture extends through the entire thickness of the bone. One of the characteristics of metatarsal march fractures is the large, fluffy or cottony callus that is present at the fracture site. This, however, is not true of fractures involving the neck. In this locality there is slight production of callus. The fluffy appearance of the callus makes this condition easily mistakable, by the uninitiated, for an osteogenic sarcoma or a Ewing's tumor. After four to six weeks the callus becomes organized and a fusiform swelling is present at the site of the fracture. Angulation at the fracture site is not common but may occur.

With hospitalization, after four to six days of bed rest, the swelling and pain subside. At this Station Hospital, soldiers with march fractures are kept at bed rest for three weeks. To prevent too much loss of training, they are sent to the reconditioning program for two to four weeks, and at the end of this period are returned to full duty.

In a small percentage of cases some patients complain of pain in the foot three or four months after injury. This can be attributed to, first, the attitude of the soldier toward military training, secondly, the soldiers pain threshold, and thirdly, excessive callus formation, which is comparatively uncommon.

A number of my patients were allowed weight bearing on the heel after pain and swelling subsided, i.e., in seven to ten days. My impression is that there is no appreciable difference in the amount of callus formation at the fracture site in patients who are kept at bed rest for the entire period of three weeks or when early heel weight bearing is permitted. A patient with a painful foot voluntarily restricts the amount of weight placed on that foot. No case of non-union and extremely rare cases of slow union were observed. It appears that metatarsal fractures are comparable to fractures of the humerus, treated by hanging-case method, in that incomplete immobilization and motion at the fracture site does not delay or prevent union. This is best explained on the basis of the excellent blood supply. In none of my cases was the foot immobilized in plaster.

PROGNOSIS

Approximately 99 per cent of these patients made a good recovery without further disability or pain, returned to training and eventually to full military duty. None of the patients required discharge from the army because of disability exclusively attributable to march fracture of the metatarsal alone.

SUMMARY

1. Metatarsal march fracture is primarily an occupational disease of soldiers.

2. The author believes that metatarsal march fractures are caused by fatigue of the peroneus longus and tibialis posticus muscles.

3. March fractures are more properly termed fatigue fractures. There is no basis

for the belief, as some authors have indicated, that metatarsal march fractures are due to spasm and overactivity of the interossei muscles.

4. The presence of an atavistic foot as an etiological factor of metatarsal march fracture is greatly over-rated.

5. All of the metatarsal march fractures in this series which were investigated occurred in soldiers with normal feet, or in cases of slight degree of pes planus and in cases of pes cavus. Not a single case of severe pes planus was encountered.

6. Pre-induction occupation of the soldier does not appear to be a decisive element except insofar as the tolerance of fatigue may be concerned.

7. The thinness of the metatarsal bone plays no important rôle in the etiology of metatarsal fractures as more fractures occurred in metatarsal bones other than the thinnest.

8. All age groups from eighteen to thirty-eight were involved in metatarsal march fractures but the eighteen and nineteen year old group were chiefly affected.

9. March fractures of the metatarsals involved all bones of the metatarsal segment but chiefly the second and third of the right foot.

10. Twenty-three cases of multiple metatarsal march fractures were encountered.

11. Fractures of the metatarsal bone involved 2.35 per cent of 10,953 cases seen by the Orthopedic Surgical Section at our Station Hospital.

REFERENCES

1. BERKMAN, E. Etiological possibilities of march fractures. *J. Bone & Joint Surg.*, 25: 206–207, 1943.
2. BOSSHARDT, C. E. March fracture. A common disability of the foot in military practice. *Arch. Phys. Therapy*, 25: 41–44, 1944.
3. BOWEN, J. J. March fracture in metatarsal bones. *Med. Bull. North African Theater of Operations*, 12–17, 1944.
4. BRANCH, HIRA E. March fractures of the femur. *J. Bone & Joint Surg.*, 26: 387, 1944.
5. BRANDT, GEO. Quoted by Charles Waters & Ira I. Kaplan in the 1941 Year Book of Radiology. P. 35.
6. BREITHAUPT. Quoted by Jansen, Murk, and Meyerding, H. W. and Pollock, G. A.
7. CLEMENT, B. L. March fractures. *J. Bone & Joint Surg.*, 26: 148–150, 1944.
8. CHILDRESS, H. M. March fractures of the lower extremities. *War Med.*, 4: 152–160, 1943.
9. DEUTSCHLAENDER, CARL. Quoted by Sirbu, A. B. and Palmer, A. M., and by Meyerding, H. W. and Pollock, G. A.
10. FLAVELL, G. March fracture. *Lancet*, 2: 66–69, 1943.
11. GOLDMAN. Quoted by Meyerding, H. W. and Pollock, G. A.
12. HAMILTON, A. S. and FINKLESTEIN, H. E. March fracture. Report of a case involving both fibulae. *J. Bone & Joint Surg.*, 26: 146–147, 1944.
13. HARMON, P. H. A case of march fracture occurring in civilian practice. *Guthrie Clin. Bull.*, 13: 69–71, 1944.
14. HENSCHEL. Quoted by Chas. Waters and Ira I. Kaplan in the 1941 Year Book of Radiology. P. 36.
15. KEY, J. A. and CONWELL, H. E. Fractures, Dislocations and Sprains, 2nd ed. St. Louis, 1938. The C. V. Mosby Co.
16. KRAUSE, G. R. March fracture. *Army Med. Bull.*, 63: 132–135, 1942.
17. KRAUSE, G. R. March fracture. *War Med.*, p. 325–330, 1942.
18. LEWIN, PHILIP. The Foot and Ankle. Philadelphia, 1942. Lea & Febiger.
19. MARTIN, ANDRE. Quoted by Jansen, Murk.
20. MEYERDING, H. W. and POLLOCK, G. A. March fractures. *Surg., Gynec. & Obst.*, 67: 234–242, 1938.
21. MEYERDING, H. W. and POLLOCK, G. A. March foot. *Military Surgeon*, 86: 593, 1940.
22. MOORE, P. L. and BRACHER, A. N. March fractures. *War Med.*, 1: 50–52, 1941.
23. MORTON, D. J. Structural factors in static disorders of the foot. *Am. J. Surg.*, 9: 315, 1930.
24. OLLONQVIST and HANNSON. Quoted by Hamilton and Finklestein in the *J. Bone & Joint Surg.*, 26: no. 1, Jan., 1944.
25. PAUZAT, J. E. Quoted by Meyerding, H. W. and Pollock, G. A.
26. PETERSON, L. T. March fracture of the femur. Report of a case. *J. Bone & Joint Surg.*, 24: 185, 1942.
27. SCHULTE. Quoted by Jansen, Murk.
28. SIRBU, A. B. and PALMER, A. M. March fractures. *California & West. Med.*, 57: 123–7, 1942.
29. STECHOW. Quoted by Jansen, Murk.
30. SWEET, H. E., KISNER, W. H. and BERKMAN, E. March fractures. *J. Nat. Assoc. Chiropod.*, 33: 15, 1943.
31. SWEET, H. E. and KISNER, W. H. March fractures. *J. Bone & Joint Surg.*, 25: 188–192, 1943.
32. TERHUNE, S. R. and EDDLEMAN, T. S. Double march fracture; a case report. *Military Surg.*, 93: 310–311, 1943.
33. WEISBACH. Quoted by Jansen, Murk, and Meyerding, H. W. and Pollock, G. A.
34. WATSON, F. C. and BERKMAN, E. F. Fatigue (March) fractures of the femoral neck. *J. Bone & Joint Surg.*, 26: 404–405, 1944.
35. WILHELM. Quoted by Chas. Waters and Ira I. Kaplan in the 1941 Year Book of Radiology. P. 33.

CHLOROPHYLL AND ADRENAL CORTICAL EXTRACT IN THE LOCAL TREATMENT OF BURNS*

G. H. COLLINGS, JR., M.D.
SPARROWS POINT, MARYLAND

THE early treatment of severe burns is primarily concerned with the relief of pain, the restoration of normal osmotic equilibrium, and the maintenance of physiological water balance, but choice of local treatment is usually a matter of personal opinion based on individual experience. With small burns the local treatment becomes of primary importance, and herein lies most of the present disagreement as to method of choice. The therapeutic armamentarium for burns is, at the present time, one of the largest collection of diverse substances ever propounded for one human ailment; and the vastness of it testifies to the fact that none of the methods are completely satisfactory.

During the past few years, my interest has been concerned with the evaluation of the more promising agents in regard to their local value in the treatment of burns.[2] Local treatment may seem insignificant by comparison to the systemic problems of burns of large areas, but local treatment is, nevertheless, an important aspect of all burns. It is only in the small burns that the effects of hemoconcentration, fluid loss, shock, etc., are at a minimum; purely local physiological processes of healing can be observed; and treatments of phyiological sanity can be devised. It is hoped that knowledge so gained may be of great value also in the local treatment of large burns.

I am in complete agreement with Smith and Livingston who state, " . . . it is well to adopt a conservative and frankly skeptical point of view regarding the relatively extravagant claims of each enthusiastic contributor to the rapidly growing chemotherapeutic armamentarium available for the treatment of burns and other traumatic injuries."[22] The following experimental results are given, then, not to propound a spectacular new cure for all burns, but with three objects in view: (1) To emphasize the fact that we have too often, in our treatment of burns, overlooked or underestimated the importance of the physiological and pathological changes at the site of injury. (2) To present evidence which seems to indicate that adrenal cortical hormone has considerable value in the local treatment of burns and to stimulate further studies on this subject. (3) To present, for what it may be worth to industrial surgeons, a method that has been most satisfactory here in industrial work.

Before beginning to repair anything, whether it be some mechanical contrivance or body injury, it seems to me that one should acquaint himself with what has happened in and to the part to be repaired. This may seem trite, but the lack of such knowledge is in part responsible for our innumerable methods for treating burns. In order to understand what has happened in a burned area, one must have a knowledge of the physiological and pathological occurrences following tissue injury and in tissue repair. For this knowledge we are indebted, for the most part, to Menkin and his classical works on the subject.[14,15,16] Menkin has shown that there is a basic pattern of reaction at the site of a wound regardless of the type of injury, although the ultimate appearance may be influenced by the causative agent or the anatomical location. First, there is increased fluid passage from the blood to the exterior of the capillaries referable to the liberation of

* From the Bethlehem Steel Company, Sparrows Point Hospital, Sparrows Point, Md.

leukotaxine which increases capillary permeability. Second, fibrinogen of the proteins which escape with the fluid is precipitated as a fibrinous network. Being evidently more delicate, the fine lymphatics are damaged early and become occluded with fibrinous thrombi. The presence of the occluded lymphatics and of the precipitated fibrinogen produce a "walling off" of the inflammatory irritant. Third, polymorphonuclear leukocytes appear as a result of the chemotactic action of leukotaxine. The normal sequence of polymorphonuclears followed eventually by macrophages is controlled by the hydrogen ion concentration at the site of inflammation, and the developing local acidosis is in turn referable to disturbed carbohydrate metabolism. Fourth, an increase in number of circulating leukocytes occurs due to the liberation of a pseudoglobulin known as "the leukocytosis promoting factor." Fifth, the foregoing sequence of events ultimately leads to disposition of the irritant and allows tissue repair.

In addition, it has been found that the actual injury factor, termed "necrosin," is an euglobulin or is, at least, associated with this protein fraction.

We also have some rather definite information at hand from experience in the treatment of burns. We know that, with few exceptions, a simple sterile ointment of vaseline or other greasy base allows kindly healing and simplicity of application. The latter is of considerable importance in industrial work where industrial nurses are employed in numbers. We know that burns are especially prone to infection. It is also apparent that the actual repair of destroyed tissue is probably dependent upon the formation of one or more growth stimulating factors.

Considering this information, we may set up six cardinal requirements that we would like to meet when compounding a preparation to be used locally on burns. These requirements are basic and must be met by any agent if it is to be at all satisfactory in aiding healing: (1) Relieve pain and present a comfortable dressing for the wound; (2) be suitable in ease of application and removal to the abilities of the person who is to use it; (3) not produce further tissue damage; (4) reduce or preferably prevent entirely the increased fluid passage from the capillaries; (5) produce stimulation of tissue repair, and (6) prevent infection.

As has been stated heretofore, requirement number 1 will be satisfactorily met by a simple vaseline ointment. After many years of use on thousands of burns in the Bethlehem Steel Company's Clinics, the following preparation has been found quite satisfactory.

BI OINTMENT

Bismuth subnitrate	33.5 gr.
Paraffin	44.5 gr.
Yellow petrolatum	559.5 gr.

Bi ointment also satisfies requirement number 2 as its application or removal is one of the simplest and quickest of operations. There is no evidence that further tissue damage is produced by this ointment; therefore, we do not have objections from requirement number 3.

Since the increased capillary permeability present in a burn is caused by leukotaxine, it is evident that we must counteract the effects of leukotaxine in some way in order to meet requirement number 4. The search for some such substance has been carried on here during the past few years.

Menkin[15] and Freed and Lindner[5] have noted that adrenal cortical extract held the action of leukotaxine in abeyance, and Rhoades, Wolff, and Lee[21] have stated that the return of capillary semi-permeability after a burn was more rapid when adrenal cortical extract was given to the patient. Desoxycorticosterone has a similar but less pronounced effect, and ovarian steriods do not produce this effect.[5] In addition, there has been a great deal of work on the use of adrenal cortical extract in the treatment of shock. However, in all of these instances its use has been by

parenteral injection. To my knowledge, it has not been used locally where it might be most effective. Experimental results on its use locally added to Bi ointment will be given in succeeding paragraphs. There is much to indicate that by adding this hormone, or group of hormones, to the simple Bi ointment, requirement number 4 will be met.

It has been shown rather conclusively that, of all the agents at present available for the stimulation of cell proliferation and tissue repair, chlorophyll probably has the most constant and marked effect. Hence, it seemed advisable to add this agent to the burn ointment in order that we might achieve maximum tissue repair in the shortest possible time. To date, its use by other investigators has been limited, but results have been excellent. Therefore, in order to meet requirement number 5, chlorophyll has been added to the formula, and as will be shown, the results have not been disappointing.

With careful initial technic and the utmost care in redressing burns, the problem of infection (requirement 6) may be solved in the majority of cases. Nevertheless, it is quite comforting to have a bacteriostatic or antiseptic agent at the site of burn to aid in control of infection. Probably this fact more than any other has led to the great numbers of agents in use at the present time. All have advantages and disadvantages. The sulfonamides have received their share of attention in this field, and one would be tempted to add a member of this group to our hypothetical ointment. However, the local use of sulfonamides is not by any means devoid of dangers and disadvantages. For this reason, I have not included a sulfonamide drug, but have relied on the bacteriostatic effect of chlorophyll and on careful technic to maintain a relatively sterile wound. Chlorophyll, to be sure, is not a true antiseptic nor is it a strong bacteriostatic agent, but as will be demonstrated, it will produce sufficient effect to obviate the necessity for a stronger agent or a sulfonamide drug. In addition, it has the advantage of not producing further tissue damage.

From a theoretical standpoint, we have an ointment that should meet all the requirements that we have enumerated. The agents chosen seemed to be the most promising for each requirement, and we have added adrenal cortical extract on a completely theoretical basis. It remained to be seen whether the results anticipated would be clinically evident. Three ointments were compounded:

1. Bi Ointment (formula given previously).
2. Bi Chlorophyll Ointment
   This consisted of the plain Bi ointment to which had been added the water soluble fraction of chlorophyll* to the extent of 1 per cent by weight.
3. Bi Chlorophyll Adrenal Ointment
   This consisted of Bi chlorophyll ointment to which had been added adrenal cortical extract† to the extent of 2¼ per cent by weight.

Ninety-one cases of industrial burns were treated with these ointments as a preliminary trial. Cases were chosen at random for the various treatments except where comparable bilateral areas were burned, in which case, one area was treated by one method and the other area by a different method for comparison. The wounds ranged in size from small second and third degree spot burns to first, second, and third degree burns of 150 to 175 square inches, and were produced by a wide variety of agents. In all cases the ointment was spread on sterile cotton lint cloth and the cloth was applied to the wound ointment side down. When possible, a firm gauze bandage held this dressing in place; otherwise, adhesive tape was used to maintain apposition of the dressing. Admittedly, the number of cases is not large, but the results were sufficiently impressive that it was believed advisable to report them in order that others who may have an opportunity might become interested in giving these agents further clinical trials. In the following tables the

* Courtesy Rystan Company, New York, N.Y.

† Upjohn—50 dog units per cc. (purchased on the market).

burns have been classified according to depth of destruction as first, second, and third, degree, and in addition, all deep second degree spot burns have been placed in a separate classification because of their characteristically poor healing.

control group, but with the deeper burns (second degree spot and third degree) there was considerable decrease in healing time which can be attributed only to the chlorophyll as this was the only agent present which was not also in the control.

TABLE I

	Bi Ointment				Bi Chlor. Oint.				Bi Chlor. Adr. Oint.			
Degree	1st.	2nd.	2nd. Spot	3rd.	1st.	2nd.	2nd. Spot	3rd.	1st.	2nd.	2nd. Spot	3rd.
Average size (sq. inches)	41.9	28.8	.78	3.0	32.5	9.0	1.3	1.5	26.7	21.0	.8	1.0
Observed healing time (days)	10.4	16.0	13.6	86.0	8.7	8.9	13.0	26.7	6.7	8.0	6.0	15.0
Expected* healing time (days)	10.4	16.0	13.6	86.0	8.1	5.5	21.8	43.0	6.7	11.8	14.1	28.7

* Based on the time that a similar size burn would have been expected to heal if treated with Bi Ointment.

TABLE II

	Bi Ointment				Bi Chlor. Oint.				Bi Chlor. Adr. Oint.			
	1st.	2nd.	2nd. Spot	3rd.	1st.	2nd.	2nd. Spot	3rd.	1st.	2nd.	2nd. Spot	3rd.
Infection rate per cent	0.0	18.0	25.0	28.0	0.0	0.0	0.0	0.0*	0.0	0.0	0.0	0.0
Loss of fluid (per cent of cases in each group)												
None	100	15	33	0	100	12	0	34	100	64	100	0
Slight	0	50	42	90	0	44	0	33	0	36	0	96
Moderate	0	26	17	10	0	44	0	33	0	0	0	4
Marked	0	9	8	0	0	0	100	0	0	0	0	0
With fluid loss time to dry (days)	...	8.6	8.8	10.1	...	4.5	5.0	9.0	...	2.7	3.0	5.0

* One case infected when Bi chlorophyll ointment applied—rapidly cleared of infection.

In Table 1 are given the results of these experiments in regard to healing time. Burns were considered healed when completely epithelialized, non-tender, and non-inflammatory so that no dressing or protection was necessary. Using the healing time per square inch for each type of burn in the control group (Bi ointment) as standard, expected healing times were computed for the other two groups so that figures might be comparable as regards size of burn.

Considering Bi chlorophyll ointment, it will be noted that there was no beneficial effect on healing time of first, and second degree burns over and above that of the

Considering Bi chlorophyll adrenal ointment, there was no beneficial effect on first degree burns, presumably because the skin here remains impervious to these agents, and their local application is without effect. However, all other burns, where there was opportunity for absorption, (second degree, second degree spots, and third degree) were healed much more rapidly than expected, and the reduction in healing time was even greater than that produced by Bi chlorophyll ointment.

In Table II are given other measures of the effectiveness of these ointments.

Infection. Cultures were not taken. By infection is meant grossly observable in-

fection: purulent exudates, local elevation of temperature and inflammation in excess of that expected for the size burn, lymphangitis if present, and other clinically evident signs. Undoubtedly, most of these burns were not bacteriologically sterile, but the classification is sufficiently exact for the purpose here. Note in Table II that the clinical infection rate was zero in all burns treated with ointments containing chlorophyll, and also note that the addition of adrenal cortical extract did not interfere with chlorophyll in this effect. All burns were treated with the same surgical technic. No débridement was done except for the removal of completely separated tissue and where otherwise necessary to combat infection. It has been the experience here that the operative removal of blistered or devitalized intact tissue is not advantageous and often is actually detrimental to healing.

Fluid loss at the site of the burn. The fluid lost from the site of a burn cannot readily be collected and measured, but an effort was made to estimate it by observing the following factors: (1) The amount of fluid present under blisters, (2) severity of the local edema, and (3) the amount of fluid absorbed in the dressings. On the basis of these observations the burns were classified according to fluid loss as none, slight, moderate, and marked. In addition, the length of time required for the burn surface to dry was recorded. On the basis of these findings it is believed that a reasonably accurate comparison of the different treatments can be made. These figures are given in Table II. It will be noted that Bi chlorophyll ointment had little or no effect on fluid loss, whereas there was a definite and marked decrease of amount and severity of exudation when adrenal extract was used (Bi chlorophyll adrenal ointment). There were several cases with bilaterally similar burns in all of which the side treated with Bi chlorophyll adrenal ointment lost less fluid and dried much sooner than the control side. If these results are verified by others in the treatment of larger burns, adrenal extract may prove to be of value in reducing the amount of intravenous plasma used in burns.

CONCLUSIONS AND COMMENTS

Much larger series of cases are necessary before any of these findings may be considered fact, but the following observations seem to be justified at this time:

1. In the first degree burns the skin does not absorb appreciable quantities of either chlorophyll or adrenal cortical extract, so that no beneficial effects are encountered in the addition of these agents to a simple vaseline ointment.

2. Epithelial proliferation and wound healing are definitely accelerated by the local application of chlorophyll, and this is in all probability due partially to its bacteriostatic effect. Using ordinary aseptic precautions, chlorophyll is the only agent necessary for the maintenance of a surgically clean wound.

3. Adrenal cortical extract applied locally, reduces the local edema and fluid loss from a burned surface, aids drying, and promotes healing. Theoretically, the mechanism of this action is its inhibitory effect on leukotaxine. It remains to be seen just how profound this effect will be on burns of larger areas.

4. Débridement of burns as ordinarily practised is not necessary and may be actually harmful in many cases.

5. The following method of preparation of Bi chlorophyll adrenal ointment has been found very satisfactory for combining the effects of a greasy base with chlorophyll and adrenal cortical extract, and has been very satisfactory for industrial uses.

Bismuth ointment containing bismuth subnitrate 33.5 gr., paraffin 44.5 gr., and yellow petrolatum 359.5 gr. to the ounce may be purchased in desired quantities. The consistency can be controlled by the amount of paraffin or petrolatum added to this ointment. Here, we add about 200 gr. of yellow petrolatum to the ounce. This mixture is then Bi ointment as referred to

heretofore. To a weighed amount of this ointment is added 1 per cent of chlorophyll by weight. The mixture is autoclaved, allowed to cool, and may be stored for long periods of time. Adrenal cortical extract is added to the extent of 2½ per cent by weight, and the mixture is stirred with a sterile spatula until homogenized. The stability of adrenal extract in this ointment is not known, and until such information becomes available, the final ointment should be made up fresh every four to five days.

REFERENCES

1. Andrus, W. D., Nickel, W. F. and Schmelkes, F. C. Treatment of burns with chemotherapeutic membranes. *Arch. Surg.*, 46: 1, 1943.
2. Collings, G. H., Jr. Local therapy for industrial burns. *Ind. Med.*, 12: 301, 1943.
3. Cook, E. S. and Fardon, J. C. Wound hormone concept in wound healing. *Surg., Gynec. & Obst.*, 75: 220, 1942.
4. Cook, E. S. et al. Yeast extracts to overcome depressant effects of germicide on skin respiration. *Proc. Soc. Exper. Biol. & Med.*, 50: 210, 1942.
5. Freed, S. C. and Lindner, E. Effects of steriods of adrenal cortex and ovary on capillary permeability. *Am. J. Physiol.*, 134: 258, 1941.
6. Goldberg, S. L. Use of water soluable chlorophyll in oral sepsis. *Am. J. Surg.*, 62: 117, 1943.
7. Gahan, E., Kline, P. R. and Finkle, T. H. Chlrophyll in the treatment of ulcers. *Arch. Dermatol. & Syphilol.*, June, 1943.
8. Gruskin, B. Chlorophyll—its therapeutic place in acute and suppurative disease. *Am. J. Surg.*, 49: 49, 1940.
9. Hamilton, J. E. Comparative study of local burn treatments. *Am. J. Surg.*, 58: 350, 1942.
10. Helfrich, L. S., Cassels, W. H. and Cole, W. H. Cortical extract in treatment of shock. *Am. J. Surg.* 55: 410, 1942.
11. Holmes, G. W. and Mueller, H. P. Treatment of post-irradiation erythema with chlorophyll ointment. *Am. J. Roentgenol. & Radium Therapy*, 50: 210, 1943.
12. Koerber, K. A. Rapid rehabilitation in the shipbuilding industry. *Am. J. Surg.*, 63: 192, 1944.
13. May, H. Treatment of burns. *Am. J. Surg.*, 63: 34, 1944.
14. Menkin, V. Cellular injury in relation to proliferative and neoplastic response. *Cancer Research*, 1: 548, 1941.
15. Menkin, V. Effect of adrenal cortex extract on capillary permeability. *Am. J. Physiol.*, 129: 691, 1940.
16. Menkin, V. Studies on isolation of factor responsible for tissue injury in inflammation. *Science*, 97: 165, 1943.
17. Menkin, V. Further studies on effect of adrenal cortex extract and of various steriods on capillary permeability. *Proc. Soc. Exper. Biol. & Med.*, 51: 39, 1942.
18. Nutini, Leo. Physical agents in tissue repair. *Arch. Phys. Therap.*, 23: 285, 1942.
19. Nutini, Leo.[17]
20. Rabinowitz, H. M. and Pelner, L. Topical application of horse serum in treatment of extensive burns. *Am. J. Surg.*, 64: 55, 1944.
21. Rhoads, J. E., Wolff, W. A. and Lee, W. E. Use of adrenal cortical extract in treatment of traumatic shock of burns. *Ann. Surg.*, 113: 955, 1941.
22. Smith, L. W. and Livingston, A. E. Chlorophyll. *Am. J. Surg.*, 62: 358, 1943.
23. Smith, L. W. and Livingston, A. E. Wound healing. *Am. J. Surg.*, 67: 30, 1945.

ESOPHAGEAL DIVERTICULUM*

FRANK BORTONE, M.D.
Diplomate of the American Board of Surgery; Attending Surgeon, Christ Hospital; Chief Thoracic Surgeon, Hudson County Tuberculosis Hospital
JERSEY CITY, NEW JERSEY

"THESE developments have been variously called esophageal diverticula, pharyngo-esophageal diverticula or pouches; pressure pouches, pharyngoceles; or retrocricoid pharyngeal diverticula. It is now known that their site of origin is always the same—in the median line of the posterior wall of the esophagus in the hypopharynx directly opposite or immediately below the cricoid. Actually they arise just above the beginning of the esophagus. The pouch, which projects from the posterior aspect of the esophagus on the left side, is made up of the mucous and submucous layers of the pharynx. It bulges through a transverse opening forced between the pars obliqua and pars fundiformis of the cricopharyngeus muscle (inferior constrictor of the pharynx), just above the beginning of the esophagus. Formerly thought to be embryonic, they are now considered to be due to mechanical pressure." This discussion does not include traction diverticula which as a rule rarely cause symptoms.

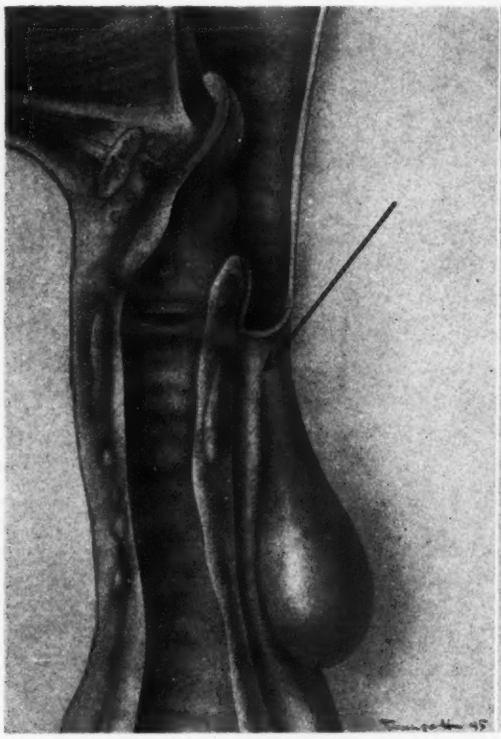


FIG. 1. Danger point perforation.

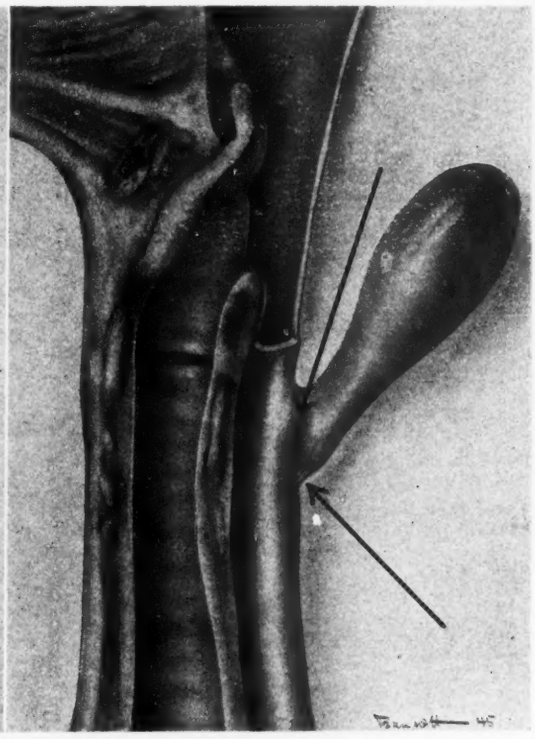


FIG. 2. Neck really not dissected; recurrence the result.

The area of the esophageal diverticulum should be fluoroscoped to determine in which direction the sac extends, i.e., to the right or left side. The incision should naturally correspond to the side of the neck in which the sac protrudes. Fluoroscopy is important since in some cases the

* Presented before Annual Meeting of the Society of Surgeons of New Jersey, January 31, 1945.

sac may project into the right side of the neck, and if the usual left approach is employed one will find himself in difficulty.

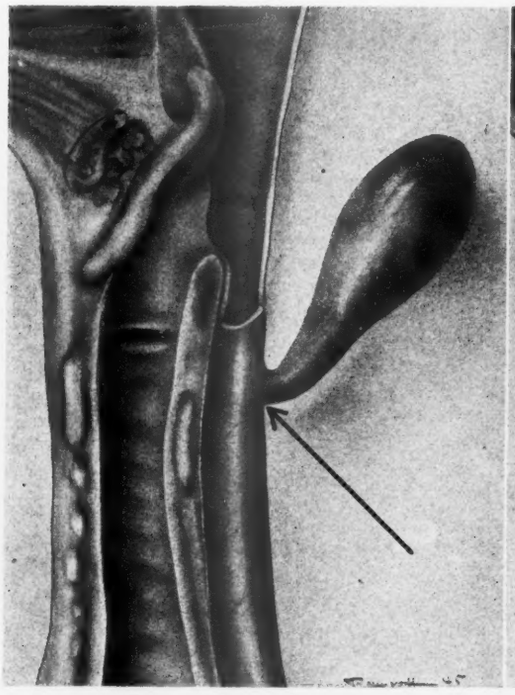


Fig. 3. Proper dissection.

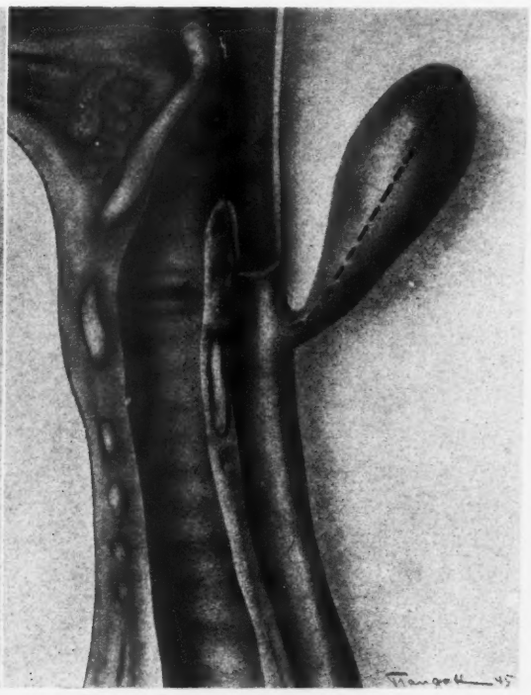


Fig. 4. Sac cut along its long axis.

The skin incision is usually made along the anterior border of the left sternocleidomastoid from the superior border of the thyroid cartilage to the suprasternal notch. The deep cervical fascia is opened by dividing it along the anterior border of the sternomastoid muscle, and the latter dissected from its fascial sheath and retracted laterally. The ribbon muscles (omohyoid, sternohyoid and sternothyroid) on the thyroid are dissected free and retracted medially. The superior belly of the omohyoid is detached from its insertion on the hyoid bone and is either freed or resected down to its tendon. The ribbon muscles must be divided in some cases to secure better exposure. There is always severe bleeding in severing the attachment of the omohyoid to the hyoid bone. This is, however, easily controlled. The ribbon muscles are grasped with the forceps and retracted medially exposing the thyroid gland. The branches of the superior thyroid artery are exposed, ligated, and divided. The inferior thyroid artery may or may not be exposed and divided. Both arteries are generally severed, however, to obtain better exposure of the esophagus which lies medial to these vessels. It is usually also necessary to divide the middle thyroid veins.

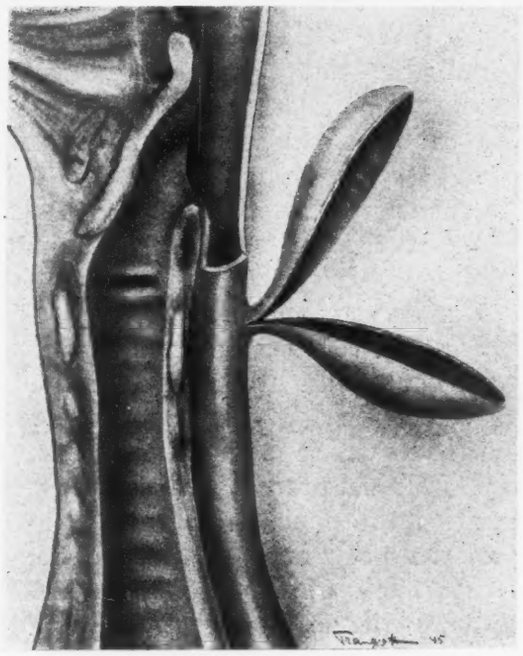


Fig. 5. Result—dog-ear flap.

The dissection is carefully carried along the lateral aspect of the thyroid gland retracting and rotating the larynx toward the opposite side while retracting the carotid and jugular vessels toward the lateral aspect of the wound. Good retraction and free exposure are especially helpful in the operative procedure.

The diverticulum is now exposed and is carefully dissected up to the neck of the pouch at its attachment to the esophagus. It is essential that the muscle fibers of the inferior constrictor at the neck of the sac be severed. During this exposure severe hemorrhage which is easily checked may occur. One must proceed with caution while separating the pouch from the esophagus toward its neck because there is danger of perforation of the esophagus at the junction of the neck of the pouch with the esophagus. If perforation occurs, suppurative mediastinitis will result and probably death. (Figs. 1, 2 and 3.)

When the pouch has been completely freed and properly separated the fundus is turned superiorly and attached to the fascia of the ribbon muscles of the neck in such a manner that the sac drains downward and readily empties itself. The patient now has no difficulty in swallowing and fluids can be immediately given postoperatively. It is of the utmost importance that only the fascia of the fundus be attached to the prethyroid muscles and that neither the suture nor the needle penetrate the sac itself; otherwise sepsis will result and probably death. In order to locate the pouch easily in the second stage it is well to leave several long silk sutures attached to the fascia of the fundus inasmuch as possible shrinking of the sac during the interim will make it difficult to find. A cigarette drain with gauge protruding is packed into the wound in such a manner that the superior mediastinum is walled off. The skin incision is closed and the second stage is performed within eight to ten days.

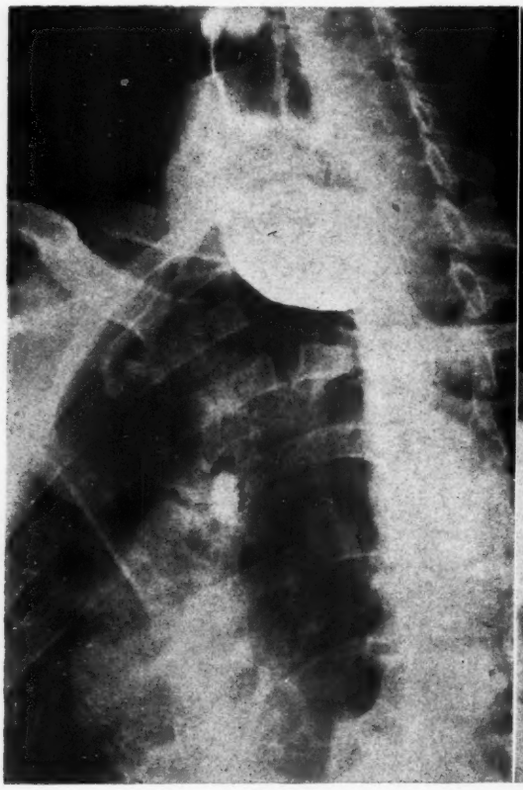


Fig. 6. Lateral view of a large diverticulum.

Fig. 7. Lateral view ten days postoperatively, showing fundus turned superiorly and attached to the fascia of the ribbon muscles of the neck.

Eight to ten days later depending upon the patient's condition the second stage is conducted. The neck is opened and the sac exposed as described for the first stage. A dog-ear flap is made by cutting the sac along its long axis. (Figs. 4 and 5.) The two flaps of the sac are cut off at its junction with the esophagus. The opening into the esophagus is roughly closed by either continuous or interrupted gut sutures. Rough closure is good enough since leakage will occur regardless of the method used for closure. The leakage is insignificant at this time since the superior mediastinum and cervical tissues have been walled off by packing in the previous operation. A cigarette drain placed in the wound is left for seven or eight days. A Levine tube inserted through the nose to the stomach is used for feeding. (Figs. 6 and 7.)

REFERENCES

Bickham. Operative Surgery. Vol. III, p. 648, by W. B. Saunders Company, Copyright, 1924. The Lahey Clinic. Personal visit, October, 1944.

The presence of adenoids may be inferred by the characteristic facies and proved by palpation. Chronically infected adenoids should be removed, and their removal comes within the scope of minor surgery.

From "Minor Surgery" edited by Humphry Rolleston and Alan Moncrieff (Philosophical Library).

MODIFICATIONS OF THE TROCAR METHOD WITH POSITIVE PRESSURE FOR INSTILLING AMNIOTIC FLUID CONCENTRATE INTRA-ABDOMINALLY AT THE CLOSE OF OPERATIONS

H. J. MERKLE, M.D.
LOS ANGELES, CALIFORNIA

CERTAIN modifications of the technic for instilling amniotic fluid concentrate intra-abdominally at the close of operations previously described[1] seem expedient for the purposes of providing an apparatus which will have the maximum durability and flexibility of operation, and at the same time, facilitating the instillation more efficiently and quickly of the fluid in as large a quantity (up to a 1,000 cc.) as is desirable. The full assembly of this apparatus consists of:

1. A 90 cc. metal syringe with a Luer-Lok attachment at the tip of the outlet.

2. A two-way metal valve which is essentially the same as described[1] except that the male part of the valve has been adapted into a tubular metal extension. This extension is 3.1 cm. long and is securely fastened to the valve, but removable. (Fig. 1.)

3. A solid rubber stopper, size 7, height 2 cm., and 55 Shore hardness. The stopper has a depression on its superior aspect sufficient to seat the body of the valve snugly, as well as a vertical groove allowing the close approximation of that part of the valve which is attached to the tubular metal extension.

4. A pure gum rubber sleeve serum stopple; stopple 2.5 cm. in diameter and 25 Shore hardness. The stopple has an excentrically placed opening which is 1 cm. from its circumference and 0.8 cm. in diameter.

5. A one liter Pyrex aspirator flask.

6. A pure gum rubber tubing 31 cm. in length, with a diameter of 2 cm. and a wall of 0.4 cm. thickness.

7. A Hoffman cut-off, 2.8 by 2.1 cm.

8. A Vitax reducing connecting tube, 1.3 to .6 cm., 7.8 cm. in length.

9. A pure gum rubber tube 112 cm. long, 0.8 cm. diameter, 0.2 wall thickness.

10. A trocar which is the same as to length, diameter, and series of openings as previously described.[1] The stylet is unchanged. Changes in the construction of the trocar consist of fixation of a flat piece of metal as an integral part of the trocar. This addition, is 3.7 by 2.3 by 0.1 cm. with its four corners slightly rounded. It is fixed 2 cm. from the proximal end of the trocar, so that the center of the flat piece of the metal's longest diameter is at right angles to the shaft of the trocar. At the distal end of the trocar, each alternate opening in the series of openings has been enlarged. Thus there are thirty openings 0.2 cm. and a like number 0.1 cm. in diameter. (Fig. 2.)

11. A stainless steel five liter solution bowl.

12. A stainless steel 14.5 cm. funnel.

13. A 220°F. laboratory thermometer, 30 cm. in length. (Fig. 3.)

14. Sterile long fiber cotton.

15. Sterile gauze. The entire assembly is placed upon a table under the customary conditions of asepsis.

The following procedure is used when amniotic fluid concentrate is used from rubber stoppered glass containers: (1) Clean off label and outside of bottle without wetting the gelatin-like covered stopper. (2) Dip top of bottle and entire neck of the bottle into an antiseptic solution composed of:

Trikresol
Carbon tetrachloride
Benzol
Acetone
Isopropyl alcohol, 99% aa 150.00

(3) Wipe top and neck of bottle with sterile gauze. (4) Remove gelatin-like cover of stopper with a forcep. However, gelatin-like cover may be removed before step 2, and, when this is done, step 4, 5 and 6 may be eliminated. (5) Dip top and neck of the bottle into the antiseptic solution again. (6) Wipe stopper and neck of bottle with sterile gauze to remove antiseptic. (7) Remove rubber stopper. (8) Wipe inside of neck of container where rubber stopper had been fastened with a gauze wick, slightly moistened with the above antiseptic. Wipe with an upward and outward motion so as not to push any particles possibly present into container's solution. (9) Wipe inside of neck of the bottle with a dry gauze until thoroughly dry. (10) Wipe top and neck of bottle with dry gauze until dry.

The use of glass stemmed containers for the amniotic fluid concentrate, thus eliminating the use of rubber stoppers, would remove some of the above precautionary measures. The steel funnel which is fitted with a piece of long fiber cotton, sufficiently large, and so placed as to act as a filter, but not as a tightly fitting plug, is inserted into the mouth of the Pyrex aspirator flask. The flask's outlet at the base is adapted into the large sized rubber tubing (2 by 31 cm.), and the Hoffman cut-off is closed securely with the right hand aided by the compression of the rubber tube by the thumb, first and second fingers of the left hand, about 12 cm. from the flask. Now the desired amount of the aqueous solution of the amniotic fluid concentrate is filtered through the funnel into the aspirator flask. When this is done, the

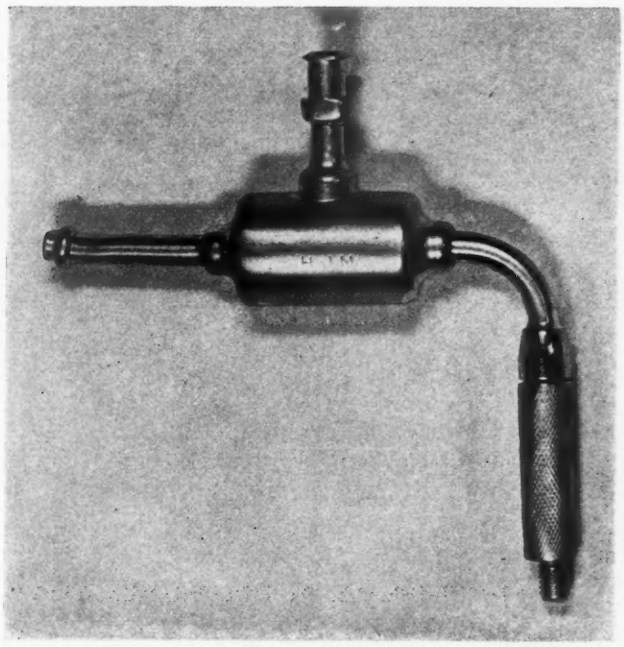


Fig. 1. Photograph of two-way valve with extension.

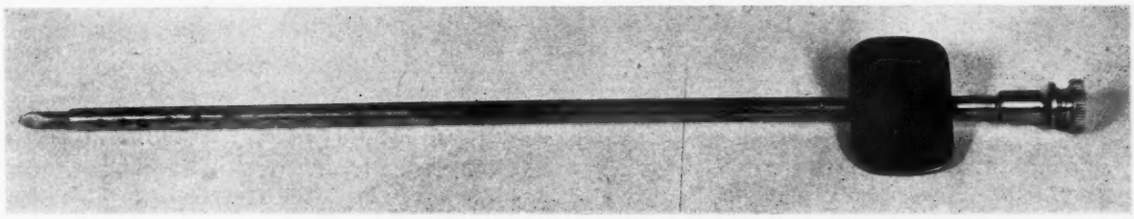


Fig. 2. Photograph of trocar with stylet.

fluid is ready to be warmed to the desired temperature which is slightly above that of the normal body. This is done by placing

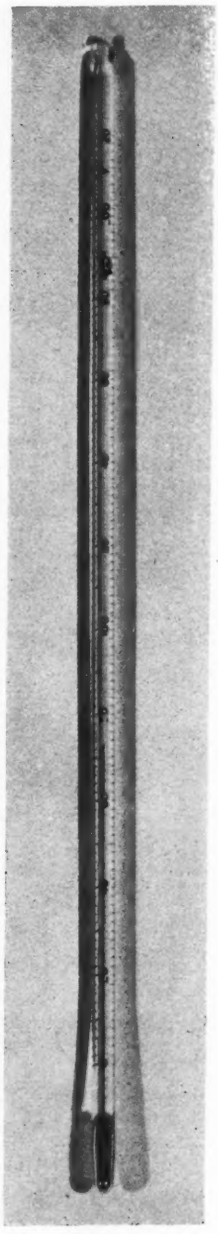


Fig. 3. Photograph of thermometer.

the Pyrex aspirator flask containing fluid in the center of the solution bowl and pouring hot water around the flask. This must be done at such a distance from the patient so there is never any possibility of spilling hot water on him. The sterilized thermometer (Fig. 3) is inserted into the mouth of the flask to the bottom of the contained solution. The temperature of the fluid will rise very rapidly to the desired temperature, slightly above normal. The thermometer is withdrawn and discarded. The flask with the attached rubber tubing is removed from the solution bowl and placed on the instrument table so that the aspirator flask's outlet faces the patient's head and is parallel to the axis of the body.

The large end of the Vitax reducing connecting tube is adapted into the distal opening of the rubber tubing attached to the outlet of the aspirator flask and the other end is adapted into one opening of the rubber tubing 0.8 by 112 cm. The proximal end of the trocar is adapted into the free end of the latter rubber tube. The method of inserting the trocar with its dull stylet into the abdominal cavity has been described elsewhere[1] and the procedure is the same except that care should be taken that the small incision made in the anterior abdominal wall should follow as closely as possible the rule of making an incision in the same general direction as the muscle, nerves, and vessels. The sutures for closure of the small opening are most conveniently placed in the muscles and skin, while the fingers of the left hand are still functioning as a guide from within the abdominal cavity at the time of the insertion of the trocar intra-abdominally. The sutures are left untied until later.

The tubular extension fastened to the two-way valve is adapted into the sleeve serum stopple, and the solid rubber stopper with its depressions is fitted appropriately and snugly between the body of the valve and the stopple. The stopple is adapted into the mouth of the aspirator bottle so that the horizontal free end of the two-way valve is directed opposite to the direction of the flask's outlet. The sleeve of the serum stopple is drawn down over the mouth of the flask. The vertical opening of the valve is readily adaptable into the Luer-Lok attachment of the tip of the 90 cc. metal syringe. (Fig. 4.)

The Hoffman cut-of is now opened completely. Positive pressure is exerted upon

the fluid in the flask by movement of the syringe's piston which by being withdrawn sucks air into the syringe. Compression by downward pressure forces the air into the Pyrex flask forcing the fluid out of the outlet into the tube and trocar into the abdominal cavity. In this way, the desired quantity of amniotic fluid concentrate up to 1,000 cc. can be instilled quickly intra-abdominally. When the flask appears empty, the sleeve serum stopple and valve are removed from the flask's mouth and the flask is elevated a short distance from the instrument table draining any possibly remaining drops of solution in the tube, etc., into the trocar. The trocar is then removed from the abdomen, and the previously inserted sutures are tied closing the small incision.

Prostigmin is given subcutaneously as soon as the fluid has been instilled. The dosage of prostigmin in ampules 1:4000 (or 1:2000 in patients weighing over 60 kg.) is similar to that advised for usage by Boehme.[2]

Fig. 4. Photograph of apparatus arrangement for instillation of fluid and solution bowl and funnel.

COMMENTS

The above are modifications of a similar method previously described[1] to provide a more uniform distribution of amniotic fluid concentrate within the abdomen and reduce the possibilities of its escape when closing the peritoneum. The changed technic differs in that it allows the elimination of a 100 cc. glass syringe, a glass Kelly jar with supporting stand, and a glass funnel. The improved type trocar (Fig. 1) facilitates manipulation of that instrument by the left thumb, and first and second fingers. The metal two-way valve is no longer adapted into the trocar's proximal end. This affords greater flexibility. The amniotic fluid concentrate is not sucked into a syringe via tube from the Kelly jar, and, then pushed through the trocar.

This saves time and work. Also, there is less opportunity for the aqueous solution of amniotic fluid concentrate to lose temperature by cooling. Less assistance is necessary, because, as soon as the trocar has been inserted, and, the peritoneum of the primary abdominal incision closed, one operator may perform the necessary steps unaided to the completion of the fluid's intra-abdominal instillation, while, simultaneously, others may proceed with the closure of the abdominal wound.

Adams[3] wrote in 1913 that stimulation of peristalsis to prevent adhesion was important, and the rapidity of peristalsis must be considered to militate against the formation of adhesions. This opinion has been expressed repeatedly. On the continent, Payr[4] urged the early postoperative stimulation of intestinal peristalsis, and said that the more independent motion that an abdominal organ had, the more it is protected against tenacious adhesions, and the quicker it will free itself from such conditions. Prima[5] substantiated the necessity for increasing peristalsis to prevent adhesion formation.

Opinions differ as to the manner in which peristalsis should be stimulated, postoperatively. Some, especially European surgeons, have advocated early feeding in the postoperative management of patients; but experience seems to show that the best postoperative care, in general, where there has been abdominal surgery, should include the withholding of food by mouth for several days at least, and, as Boehme[2] stated recently, the restriction of oral intake of fluids for twenty-four to thirty-six hours.

An effective means in common use of stimulating peristalsis is by use of such drugs as prostigmin and pitressin. Prostigmin is employed for this purpose as described above when amniotic fluid is instilled, and also by constantly changing surfaces, to gain the best possible early distribution of the isotonic aqueous solution of amniotic fluid concentrate, that it may function as previously discussed.[1] Payr[4] said that if the wounded surfaces of serosa lying one on another are unable to free themselves in due time, a firm peritoneal soldering becomes a fixed fact for the time being. Prostigmin is given at four-hour intervals for at least three doses. Then, if no contraindication exists, pitressin, in about half the standard dose is used instead at desired intervals. The fluid requirements of the patient are maintained by parenteral administration *pro rata nata*. The importance of maintaining a normal electrolyte and fluid balance as a necessary adjunct to management of patients postoperatively is well known, as expressed by Muntwyler and Mautz.[6] Fuge and Hogg[7] have emphasized the recognization of the clinical importance of insensible loss in order that replacement be made according to the physiological requirements of the surgical patient. The opinions of Cutting et al.[8] as to the physiologic responses of the body to direct artificial addition of solutions of inorganic substances to the circulation, deserve consideration.

McIntyre[9] states that, although more than a thousand experimenters have conducted a search during the last half century for the mechanism of shock, they have failed to find any single cause capable of initiating the complex train of events seen in all cases of shock. It is not surprising that opinions differ not only as to possible causes but also as to forms of treatment to be used. Amniotic fluid concentrate when given in quantities as much as 1,000 cc. into the abdominal cavity at the close of operation, not only adds fluid to the patient before he leaves the operating room, a measure similar to that reported by Moon[10] as used for reducing the occurrence of shock following operation, but also because of its healing effect on traumatized peritoneal tissue, amniotic fluid concentrate must be considered beneficial in the treatment to prevent shock. Johnson[11] following his observations on the anesthetic and fibrin organizing effect of amniotic fluid concentrate, concluded that it might be valuable in neutralizing

the effect of traumatic stimulation of the splanchnic nerve endings in paralytic ileus. He suggested the use of large quantities of fluid after extensive surgical procedures in the abdomen. It is desirable, on the basis of anatomical and physiological facts, to use as large quantities of amniotic fluid concentrate as possible when its use is indicated. The peritoneum may be regarded, according to Jackson,[12] as a closed sac, the inner surface of which is smooth while the outer surface is rough and is attached to the tissues which surround it. In the male subject, the peritoneum forms actually a closed sac; but in the female its wall exhibits two minute apertures at the openings of the Fallopian tubes. Miller[13] states that the peritoneum secretes a slight amount of clear fluid which acts as a lubricant and so permits the viscera to move freely over one another without friction. Lewis[14] says the peritoneum is the largest serous membrane in the body, and Deaver[15] asserts its area with its reflexions and folds is almost equal to that of the integument of the body, and Massie[16] and Horsley[17] concur in this. The chief characteristic of the peritoneum writes Deaver[15] is its absorptive power which allows a quantity of fluid to be absorbed equal to the body weight within twelve to thirty hours. Hertzler,[18] while admitting that astonishing individual variations are encountered without there being apparent reasons, stresses the rapidity of the rate of peritoneal fluid absorption by the peritoneum. Also, Hertzler[19] gives the opinion that in the case of isotonic solutions, the absorption rate is the same for several half-hour periods. Piersol[20] cites Wegner as reporting that 3 to 8 per cent of the body weight in fluid can be taken up by the peritoneum from within its cavity in an hour which is equivalent to the total body weight in twenty-four hours. Thus, authorities are in agreement substantially as to the absorptive power of the peritoneum. These facts emphasize the necessity for the use of large quantities when using amniotic fluid concentrate.

Payr[4] believed the damage to the peritoneal serosa by the trauma of aseptic laparotomy was considerably more important than was generally supposed. He quoted Seifert that drawing the greater omentum forth from the peritoneal cavity for a few minutes, or touching of the peritoneal surface by a dry or wet compress produces an accumulation and migration of white blood cells and exudation of fibrin. In addition, slight chemical or thermal influences cause swelling and loosening of the surface cells, frequently, with nuclear degeneration and necrosis. Hertzler[19] adequately described the process by which the agglutination of the injured peritoneal surfaces takes place.

Prima[21] declared that hardly any other factor damages the perioneal epithelium so much as the dehydration of the tissue, and that the drying of the peritoneum favors adhesion formation. To combat the effects of dehydration he employed irrigations of warm physiological saline solutions in the abdominal cavity postoperatively. Amniotic fluid concentrate used in as large a quantity as a 1,000 cc. when possible offers an effective means of overcoming the effects of dehydration of the peritoneal surfaces at the close of operation.

Piersol[20] said the resistance of the peritoneum to infection is usually in direct proportion to the normality of its mesothelial coat which is lessened by any form of traumatism including handling, or sponging or irrigation with strong antiseptics.

A certain amount of trauma to tissues in the abdominal cavity is inevitable when they are subjected to surgical procedures. In surgery in the abdomen, when conditions permit, routine examination of the abdominal tissues has long been recognized as necessary; in fact it is often the only means of appraising the pathological condition present. This involves handling of peritoneal surfaces. Adams's[3] quotation of Grawitz's definition that peritoneal adhesions are the product of "reaction of the irritated and damaged tissues which still retain their vitality" requires considera-

tion. The importance of infection in the formation of adhesions has long been recognized. Adams[3] wrote that the presence of unsuspecting organisms accounted for many of the misfortunes of abdominal surgery, and their relation to the formation of peritoneal adhesions was a question which he thought received too little attention. He said the bactericidal power of the intact peritoneum was undeniable and yet a comparatively slight infection may be enough to ruin the perfect smoothness of the endothelial continuity, and that it is common to speak of "protective" adhesions which wall off infected areas of the peritoneum from the general cavity, but, unfortunately, these may eventually lead to intestinal obstruction and prove disastrous rather than beneficial. Other surgeons, such as McIver,[22] list inflammatory reactions in the peritoneal cavity as responsible directly and indirectly for a large group of intestinal obstructions. He said the bands, adhesions, inflammatory lymph glands, etc., that arise from inflammatory reaction in the peritoneal cavity are the result not only of bacterial inflammation of the peritoneum but also of mechanical injury, usually incidental to abdominal operations. And that the forty years, prior to his publication, that had marked the rise of abdominal surgery, intestinal obstructions following laparotomies had formed an increasingly large proportion of the total cases.

Haug[23] discussed the prevalence of abdominal adhesions after laparotomy on the basis of clinical statistics gathered from relaparotomized patients, and stressed the importance of the necessity of using every possible measure to prevent adhesion formation following abdominal surgery.

At Yale, Ives and Hirshfeld[24] demonstrated, by extensive studies on the bacteriology of surgical wounds made with due regard to all principles of aseptic surgical technic, that extensive contamination with bacteria existed.

Muller and Rademaker[25] state that adhesions after laparotomy frequently give rise to more acute symptoms than the condition for which the operation was done, and that adhesions are primarily formed by trauma on which irritation by chemicals or bacteria is superimposed. They conclude as a result of animal experimentation that infection is the primary etiological factor in the production of postoperative adhesions. However, it must be admitted that animal experimentation, in regard to adhesion formation, cannot be considered entirely satisfactory because of certain essential differences between man and lower animals. An important difference, as stated by Jackson,[12] is that the marked changes associated with extensive secondary adhesions of the primitive peritoneal structures are found only among the higher mammals, especially in man and the anthropoids, associated with the assumption of erect posture.

Even if there is some variation in opinion, as discussed above, as to the relative importance of some of the known factors causing adhesions, amniotic fluid concentrate has great importance when instilled intra-abdominally at the close of operation, as an effective agent which minimizes the formation of postoperative adhesions in a traumatized peritoneum by producing a reaction stimulating the normal processes of repair; and in the presence of abdominal bacterial contamination, it will stimulate the normal defense repair mechanism to the end that the incidence of postoperative infection will be markedly decreased and early resolution accelerated. As regards the latter, is a well known fact cited by Steinberg,[26] that when bacteria invade the peritoneal cavity, there is an initial lag of multiplication during which the microorganisms adapt themselves to the new environment. This lag varies from a few to twenty-hours depending on the environmental conditions. The great importance of attempting to exploit the advantage of this lag period for the good of the patient by the use of amniotic fluid concentrate at the close of operation is obvious

Steinberg[26] enumerates other causes for intraperitoneal adhesions. It is not the purpose to discuss further the known causes here, or those causes which in the light of present knowledge are intangible of definite explanation. That the capacity to form adhesions varies greatly in different individuals has long been universally recognized. The inherent tendency for certain patients to form massive tenacious adhesions causing serious postoperative complications has been the subject of extensive consideration by many surgeons, such as Payr[4] and Haug.[23] Maguire and Scott-Orr[27] rightly state that adhesions may form anywhere in the abdomen apparently without adequate cause, it is recognized that injured surfaces are more likely to adhere, and reperitonealization has been the sheet anchor of the modern surgeon. That the use of amniotic fluid concentrate in the abdomen at the close of operation is of great importance in the prevention of the formation of adhesions, the experiences demonstrated in previous published reports verify, but it is definitely not to be regarded as a panacea for the prevention of all possible postoperative adhesions, because many factors active in the production of these adhesions in the abdomen are insufficiently understood or are as yet beyond practical control. A consideration of the latter is essential for a necessary and proper recognition that the prevention of adhesion formation cannot be expected in every case by the use of amniotic fluid concentrate alone. In each case, the aid of medicinal measures for the solving of the problems of adhesion formation prevention in abdominal surgery includes, as paramount, a constant appreciation of the aid possible through the facilities of internal medicine. The use of amniotic fluid concentrate in the abdomen must be considered as the employment of an effective powerful agent for the prevention of adhesion formation for the reason that Adams[3] expressed long ago when he spoke of peritoneal adhesions, and said that an endeavor at prevention of adhesions is better than an endeavor to cure them when present; prevention is not only better, but easier.

Bainbridge[28] recently called attention to the formation of adventitious bands as one of the delayed or slow developments in the abdomen, occurring as a result of trauma to the abdominal viscera from the action of an impact or force acting externally to the abdominal wall. With the passage of time the effects seem unrelated to the injury itself. Since in civilian life opportunity for such types of trauma is not only frequent but apparently on the increase, a consideration of this subject is necessary for the proper evaluation of the cause of adhesion formation and the complications thereof when occurring in patients who have had abdominal surgery at some time in their lives.

Amniotic fluid concentrate has been used successfully in the treatment of some types of peritonitis, but it must be emphasized that the fluid should not be used in the perioneal cavity in the presence of pus. The surgical experience of the past with other solutions, viz, normal saline, etc., will explain why the use of amniotic fluid concentrate in the presence of pus in the peritoneal cavity is contraindicated.

The late A. J. Ochsner,[29] a pioneer in the treatment of inflammations of the abdomen, said that when during the development of a spreading general peritonitis, following, e.g., the perforation of an appendix or a gastric or duodenal ulcer, there is an acute inflammatory condition of the serosa set up by the irritation of highly toxic material in the abdominal cavity, accompanied by a free exudation of serum and migration of leucocytes into the cavity, and the development of pus, all the flow is from the vessels into the abdominal cavity, and comparatively little of the toxic material is absorbed into the blood. If this were not so, cases of general peritonitis would be far more rapidly fatal. But when the abdomen, containing a considerable quantity of septic pus, is freely irrigated by normal saline, a certain

quantity is always left behind; this fluid, which is highly toxic is rapidly absorbed into the circulation. It is well known that large quantities of normal saline, when introduced in the abdomen, are very rapidly absorbed. The current, instead of being from the blood into the peritoneal cavity, is from the cavity into the blood stream and the patient dies of toxemia.

In the light of A. J. Ochsner's[29] explanation, Schonbauer's[30] publication of successes and failures observed in Eiselberg's clinic is important and illustrative of what occurred when a pepsin hydrochloric acid solution was used in irrigation of the peritoneal cavity. The observations were carried out for three and a quarter years in a large series of cases of perforation peritonitis. Due to the abundant material available in the large clinic, opportunity for an authoritative estimation was plentiful. Quantities of 1½ to 3 liters of solution were used for irrigation in the abdominal cavity. Some of the solution remained following irrigation. The mortality rates, in general, when the solution was used in certain types of perforation peritonitis showed a marked reduction as compared to those of previous experience with other methods. However, in the failures, the late cases, in which a time interval had been long enough for progressive inflammatory changes of a septic nature to become established, the instructive case reports indicated the dire pathological consequences of a vicious fulminating toxemia. Schonbauer[30] pleaded for earlier surgical intervention as the only means by which the mortality rate could be favorably influenced saying any therapy is too late when the internal organs exhibited serious changes.

Hence when an aqueous solution of amniotic fluid concentrate is used in the peritoneal cavity in the presence of pus, an unsuccessful result is to be expected. According to Murray,[31] the use of amniotic fluid concentrate was of no avail in treatment of a case of massive seropurulent peritonitis. Gepfert's[32] experience in the use of amniotic fluid concentrate in human peritoneal cavity in the presence of pus substantiates the above opinion, and he states that it should not be used at the time of operation if the presence of pus is suspected.

In certain occasional cases, as in a massive postoperative ventral hernia of long standing, the above described technic of instillation and the use of large quantities of amniotic fluid concentrate is not desirable as a routine procedure, if the tissues of the abdominal wall show such extensive pathological changes that they are difficult to identify, and the thinned, torn peritoneum can only be closed with the greatest difficulty.

In such cases, when the peritoneum is closed, and to avoid the possibility of causing any pressure against the anterior portion of the abdominal wall, the use of a smaller quantity, e.g., 100 cc. may seem indicated. This is conveniently injected by using an ordinary 50 to 100 cc. glass syringe and a No. 19 gauge needle. The desired quantity of amniotic fluid concentrate is injected into the cavity carefully, through the lateral anterior peritoneal wall or some place where the fluid can gravitate posteriorly to a dependent portion of abdominal cavity.

What Whitaker[33] said about a surgical procedure elsewhere, may be applied here: Reason should be followed in determining the manner and quantity of amniotic fluid concentrate used in the abdomen, not a rule or a fixed course of action.

SUMMARY AND CONCLUSIONS

Some changes are given here of a technic previously described for instilling amniotic fluid concentrate by the trocar method with positive pressure at the close of abdominal operations. The purposes for the improvements are to give the advantages of an apparatus which has more durability, and flexibility with more efficiency of action, and with greater economy of time and labor to the operator and assistants than before. Certain necessary precau-

tionary measures are explained and a method suggested for use when amniotic fluid concentrate is to be used from rubber-stoppered glass containers. Several reasons are given for the necessity of stimulation of intestinal peristalsis early, beginning in the operating room upon the completion of the instillation of the amniotic fluid concentrate.

The importance is stressed for the usual necessary care in the postoperative management of fluid requirements in each case.

Amniotic fluid concentrate as given at the close of operation is of great importance in its action in contributing to the proper management of postoperative water balance requirements, and in the prevention of the postoperative occurrence of shock, especially when employed in quantities up to 1,000 cc.

Authoritative opinions are given as to the large surface area of the abdominal peritoneum and its great power of absorption which shows why there is a definite need for the use of quantities of amniotic fluid concentrate up to 1,000 cc., when its employment is indicated at the close of operations in the abdomen, to best overcome the effects of dehydration. By stimulation of the defense-repair mechanism, its action is invaluable in the prevention of the bad results of peritoneal trauma and of bacterial contaminations leading to peritoneal infections and consequent complications thereof.

Amniotic fluid concentrate should be introduced into the abdomen at the close of operations as early as possible, close as possible to the time of earliest contamination and in the lag period as described above, when it can exert its greatest effectiveness on the peritoneal defense mechanism to the best possible advantage of the human organism.

Amniotic fluid concentrate cannot be expected to act as a panacea, because many factors, constitutional, etc., active in the causation of adhesion formation, cannot be controlled in every individual case. Amniotic fluid concentrate is contraindicated in the presence of pus, because of physiological and pathological reactions, occurring under certain conditions peculiar to abdominal peritoneal tissues.

In occasional exceptional cases in which amniotic fluid concentrate instillation intra-abdominally is desirable at the close of operation the administration may be done more advantageously by another method rather than by the trocar method, and emphasis is placed on the fact that the surgeon should use that method which meets the conditions and indications of each individual case.

Amniotic fluid concentrate, when used as indicated by conditions in the abdomen at the close of operations, should be considered in the sense of an agent of insurance, a prophylaxis, a preventative of complications in abdominal surgery used for the purpose of insuring better results.

REFERENCES

1. Merkle, H. J. A new technic for instilling amniotic fluid concentrate intra-abdominally at the close of operations. *Am. J. Surg.*, 65: 210, 1944.
2. Boehme, Earle J. Management of intestinal distention (adynamic ileus) with special reference to postoperative distention. *Surg. Clin. North America*, p. 560, June, 1944.
3. Adams, Joseph E. Peritoneal adhesions. *Lancet*, 1: 663–668, 1913.
4. Payr, E. Biologisches zur Enstehung Rückbildung und Vorbeuge von Bauchfellwachsungen. *Zentralbl. f. Chir.*, 51: 718, 1924.
5. Prima, C. Zur Verhütung des postoperativen Bauchfellverwachsung. *Zentralbl. f. Chir.*, 52: 930, 1925.
6. Muntwyler, Edward and Mautz, Frederick J. Electrolyte and water equilibrium in the body. Cited by Glasser, Otto: Medical Physics. P. 371–376. Chicago, 1944. Year Book Publishers, Inc.
7. Fuge, Wilfred W. and Hogg, Bruce M. The insensible loss in surgical patients. *Ann. Surg.*, 108: 1, 1938.
8. Cutting, Reginald A., Lands, Alonzo, M. and Larson, Paul S. Distribution and excretion of water and chlorides after massive saline infusions. *Arch. Surg.*, 36: 586, 1938.
9. McIntyre, A. R. The mechanism of shock. *Nebraska State M. J.*, 29: 69, 1944.
10. Moon, Virgil H. Shock: physiologic and chemical factors. Cited by Glasser, Otto: Medical Physics. P. 1415–1420, Chicago, 1944. Year Book Publishers, Inc.
11. Johnson, Herbert L. Amfetin—its influence upon defense and repair in serous cavities. *Med. Arts and Indianapolis M. J.*, 36: 409, 1933.

12. Johnson, C. M. Morris' Human Anatomy, 9th ed., p. 1234, Philadelphia, 1933. P. Blakiston's Son & Co.
13. Miller, Robert H. Applied Anatomy. P. 306. 1938. Lea & Febiger.
14. Lewis, Warren H. Gray's Anatomy. 24th ed., p. 1169. Philadelphia, 1942. Lea & Febiger.
15. Deaver, J. Montgomery, Peritoneum. *Cycloped. Med.*, 9: 742, 1934.
16. Massie, Grant. Surgical Anatomy. 3th ed., p. 218–219. Philadelphia, 1937. Lea & Febiger.
17. Horsley, J. Shelton. Peritonitis. *Arch. Surg.*, 36: 190, 1938.
18. Hertzler, Arthur E. The Peritoneum. P. 11. St. Louis, 1919. C. V. Mosby Co.
19. Hertzler, Arthur E. Surg'cal Pathology of the Peritoneum. P. 16–32. Philadelphia, 1935. J. B. Lippincott Co.
20. Piersol, George A. Human Anatomy. 9th ed., p. 1755. Philadelphia, 1930. J. B. Lippincott Co.
21. Prima, C. Zur Frage der Ileus Mortalität. *Zentralbl. f. Chir.*, 52: 241, 1925.
22. McIver, M. A. Acute intestinal obstruction. *Am. J. Surg.*, 19: 163, 1933.
23. Haug, E. Über postoperativen Adhäs-ionen nach gynäkologischen Laparotomie. *München med. Wchnschr.*, 15: 463–466, 1923.
24. Ives, Jr., Howard Rollin and Hirschfeld, John Winslow. Bacterial flora of clean wounds. *Ann. Surg.*, 107: 607, 1938.
25. Muller, George P. and Rademaker, Lee A. Role of infection in the production of postoperative adhesions. *Arch. Surg.*, 26: 280, 1933.
26. Steinberg, Bernhard. Infections of the Peritoneum. P. 6, 59–60. New York, 1944. Paul B. Hoeber Co.
27. Maguire, F. A. and Scott-Orr, A. R. Aminoplastin in abdominal surgery. *Med. Australia*, p. 391–392. October 4, 1941.
28. Bainbridge, William Seaman. Delayed effects of trauma of the abdominal viscera. *Mil. Surg.*, 94: 135, 1944.
29. Ochsner, Albert J. Peritoneum, Mesentery and Omentum. General Surgery. P. 306. Chicago, 1924. The Year Book Publishers, Inc.
30. Schönbauer, Leopold. Über Peritonitis and Ileus, *Deutsche Ztschr. f. Chir.*, 193: 295–307, 1925.
31. Murray, F. J. Acute peritonitis, preoperative immunization with amfetin. *Nebraska State M. J.*, 27: 65, 1942.
32. Gepfert, J. Randolph. Intra-peritoneal use of amniotic fluid to promote smoother post-operative convalescence. *Am. J. Surg.*, 31: 40, 1936.
33. Whitaker, Lester R. Obstructed gallbladder. *Am. J. Surg.*, 64: 297, 1944.

MODIFICATION OF RADICAL OPERATION FOR THE CURE OF INGROWN TOENAILS

LIEUT. COL. WILLIAM L. SIBLEY
MEDICAL CORPS, ARMY OF THE UNITED STATES

THE problem of treating ingrown toenails becomes very important when it is considered that the individual having such a condition may lose a considerable period of time from his occupation or duty if the condition is not treated properly. This is particularly true when the occupation or duty requires the individual to be on his feet for its performance. Temporizing palliative procedures will not effectively cure many of the cases of ingrown nails. Such temporizing procedures are prone to be followed by recurrences as soon as the nail grows out again. The standard radical operation[1,2] for ingrown nails which entails the cutting out of a wedge of nail, matrix and skin will bring about the desired cure, but it is attended by a long period of morbidity and disability ranging from sixteen days to six weeks or more before the wound is completely healed.[2] The operations of Bennett,[3] O'Donoghue,[4] and Winograd[5] all give good results. The O'Donoghue and Bennett operations, while they produce excellent results, require the use of sutures. Experience has shown that many times the sutures cut into the skin, prolong the morbidity and increase the healing time to a greater degree than when sutures are not used. (Fig. 9.)

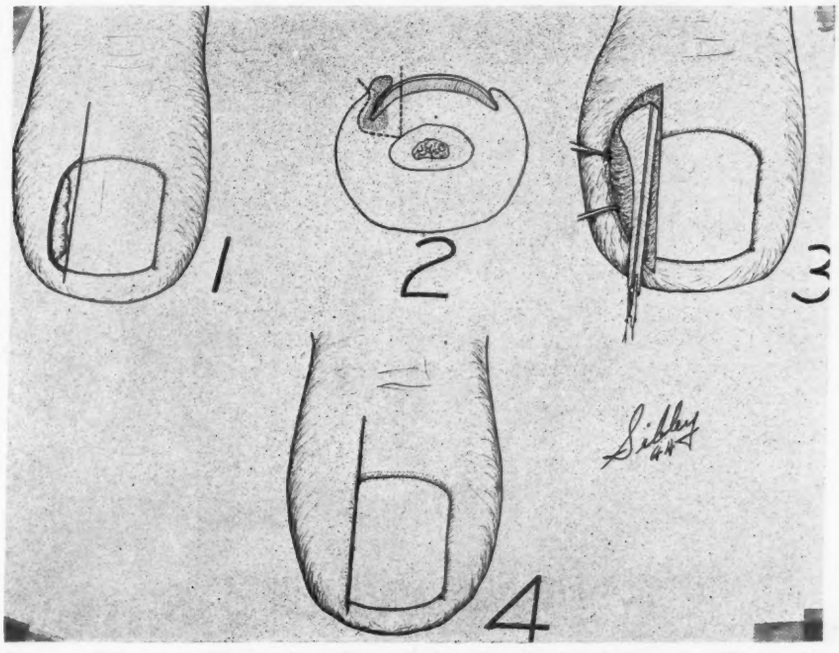


FIG. 1. Diagrams illustrating the technic of removing ingrown nail, matrix and nail bed. 1, incisions are made along lines indicated by heavy black lines. The curved lateral incision is just outside the diseased area of skin. 2, a cross section of the toe showing the wedge shape mass to be removed as indicated by broken lines. Only the diseased portion of skin is excised. 3, the diseased nail, matrix and nail bed are removed. The skin flap is retracted laterally. 4, the skin flap is pressed down in the wound leaving a clean linear scar.

It has been demonstrated at this station that sutures are not necessary for the accurate apposition of the skin flap to the

denuded area of the toe, and that healing takes place rapidly by primary intention. The apposition of the skin flap to the toe is maintained by snug-fitting padded pressure dressings. The technic used is essentially the same as that described by Bennett[3] without the use of sutures.

TECHNIC

The foot and toe are surgically prepared with an antiseptic solution Anesthesia is obtained by blocking the nerves at the base of the toe. A bloodless operative field is secured by applying a rubber band tourniquet around the proximal phalanx of the

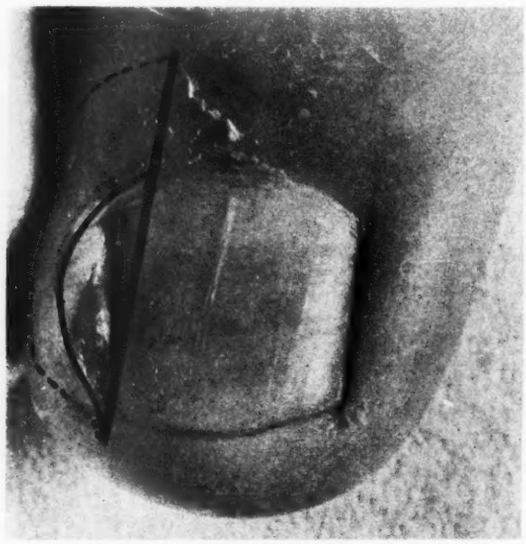


FIG. 2. Lines of incision employed in the radical treatment for ingrown toenails. Heavy solid lines indicate incisions. Broken line indicates undercutting necessary to form skin flap and remove diseased tissues.

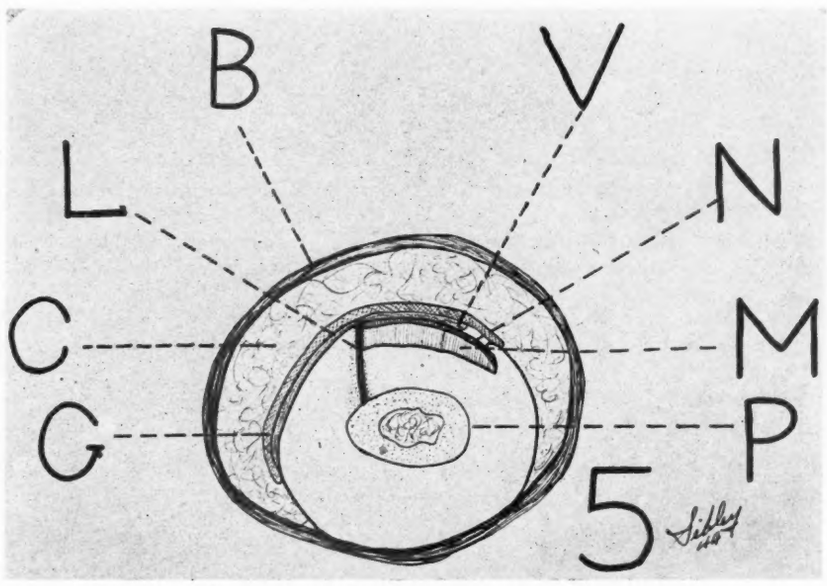


FIG. 3. Diagram illustrating method of maintaining closure of the wound (cross-section). G, one inch square gauze sponge; C, cotton for elastic pressure; L, line of incision; B, gauze bandage; V, vaseline gauze; N, nail; M, nail bed; P, distal phalanx.

toe. The lateral margin of the ingrown nail is excised with a longitudinal incision. (Figs. 1 and 2.) The incision extends into the tip of the toe in line with the excised nail margin down to the bone. A skin flap is then formed by sharp dissection of the

Fig. 4. Fig. 5.

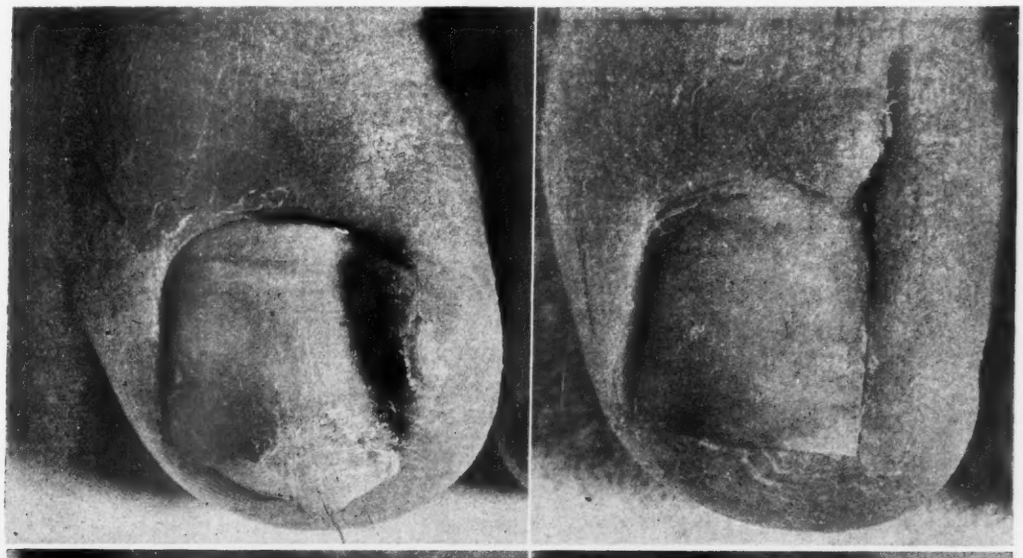


Fig. 6. Fig. 7.

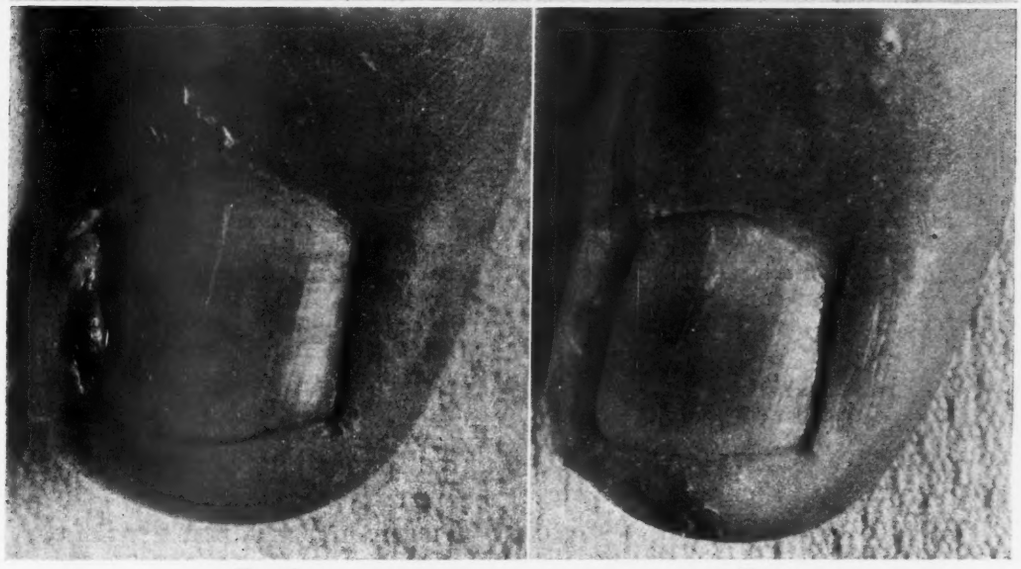


Fig. 4. Photograph of ingrown nail before radical operation.

Fig. 5. Photograph of toe shown in Figure 4 taken five days after operation. Patient was able to wear regular shoe and return to full duty. The edema around the line of incision cleared up rapidly and only a trace of scar now remains.

Fig. 6. Photograph of ingrown toenail before radical operation. Notice the small areas of fungus infection.

Fig. 7. Photograph of the toe shown in Figure 6, taken five days after operation. The wound is healed. The regular shoe can be worn. The fungus infection responded rapidly to Castellani's carbolfuchsin solution applied locally.

the skin over the nail root. The liberated nail is easily removed with a straight hemostat. The matrix and nail bed are thus exposed. An incision is made through the matrix and nail bed from the root to skin at the lateral margin of the nail bed. The matrix and nail bed are removed by cutting at right angles to the incision on top of the toe, removing the tissues in the shape of a wedge. (Fig. 1, No. 2.) This

leaves a clean, open, gutter-shaped wound with a skin flap at its lateral margin. (Fig. 1 No. 3.) A strip of vaseline gauze is placed over the wound and the skin flap is pressed down against the toe as a graft. (Fig. 1 No. 4.) A bulky pressure dressing composed of cotton and gauze is then placed on the vaseline gauze and a circular bandage is applied around the toe. (Fig. 2, No. 5.) The bandage should be so applied that the tip of the toe can be seen and inspected at all times in order to determine the state of the circulation of the part. The bandage may be cut on the undersurface of the toe and loosened if the circulation appears to be altered by the pressure dressing.

Fig. 8. Photograph taken on the sixth day after operation for ingrown nail. It reveals primary healing of wound. It illustrates the presence of a fungus infection which cleared up quickly with Castellani's carbolfuchsin solution. The patient was wearing regular shoe on this date.

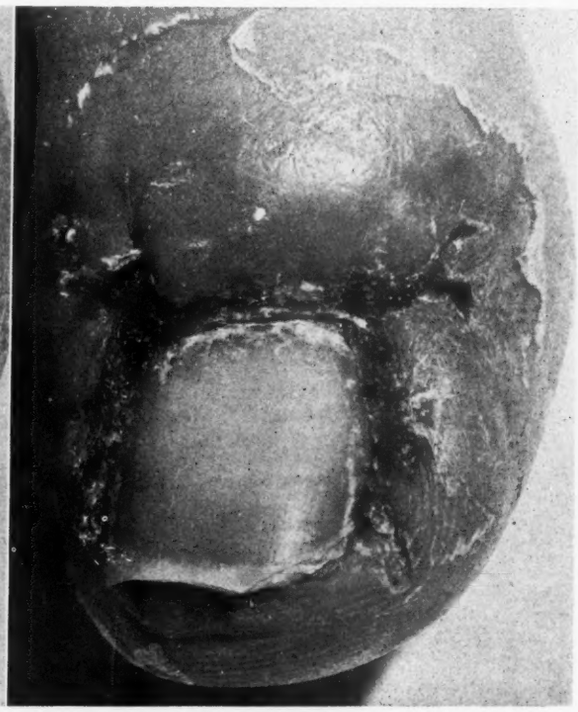


Fig. 9. Photograph of a toe taken fourteen days after bilateral ingrown nails had been excised. Sutures were used in this case and even though removed on the sixth day, they had cut deeply into the flesh. Complete healing occurred on the eighteenth day. This photograph was included in this paper for comparison with those in which sutures were not used.

SUMMARY

A modification of the operation described by Bennett is presented. It has been used quite successfully at this station. The regular shoe can be worn comfortably in from five to seven days after the operation, at which time the patient is in no further need of treatment.

Infected ingrown nails require some preliminary treatment to insure primary union of the skin flap. Frequently, associated fungus infections require additional treatment. (Figs. 6, 7 and 8.)

Diagrammatic illustrations of the technic employed are presented with photographs showing end results. (Figs. 4, 5, 6, 7 and 8.)

REFERENCES

1. Heifetz, Carl J. Ingrown toe-nail. *Am. J. Surg.*, 38: 298–315, 1937.
2. Keyes, E. L. Surgical treatment of ingrown toenails. *J. A. M. A.*, 102: 1458–1460, 1934.
3. Bennett, L. C. Radical operation with plastic closure, for cure of ingrowing nails. *Military Surgeon*, 94: 361–364, 1944.
4. O'Donoghue, D. H. Treatment of ingrown toe nail. *Am. J. Surg.*, 50: 519–522, 1940.
5. Winograd, A. M. Modification in technic of operation for ingrown toe nail. *J. A. M. A.*, 92: 229–230, 1929.

WHAT WAS WRONG WITH WHITEHEAD'S WORK?

AN APPRAISAL OF HIS RECTAL OPERATION

CHELSEA EATON, M.D.
Attending Proctologist, Peralta and Berkeley Hospitals
OAKLAND, CALIFORNIA

WALTER WHITEHEAD,* a surgeon of Manchester, England, said on November 15, 1882, "During the past five years I have been excising hemorrhoidal tumors according to a plan which I believe to be more in harmony with surgical principles than the operations in general use, and I have abandoned those pyrotechnic aids and cumbersome appliances, etc." He goes on to relate the method which he has used in the surgical treatment of more than three hundred fifty cases of severe, massive, hemorrhoidal prolapse which he designates as "the cases where the blood equilibrium is destroyed and can no longer be cared for by the physician." After stressing pre- and postoperative care, he describes the amputative operation whereby the entire hemorrhoidal mass is freely and completely dissected to the "upper limit of the hemorrhoids," after which the cut edge of the overlying mucosa is sutured to the "denuded verge."[1]

Probably no article in medical literature has caused more discussion, or more misunderstanding, or has received more abusive epithets than what is commonly supposed to be the explanation of the "Whitehead Operation." The fact that this torrent of invective has flowed steadily for three-quarters of a century and shows no sign of abating makes one wonder whether, after all, there wasn't something good about it. Where there are clouds of besmirching smoke there must be some brilliant fire.

Indeed, no one can deny that Whitehead's theory was good. The reasonableness of the idea was proved by the fact that his colleagues and followers tried repeatedly to follow his supposed plan. Some succeeded, more failed; but among those that succeeded are men who are considered to be pre-eminent today. We might consider the statement of Dr. Frank Yeomans which shows no enthusiasm for the operation, but which admits that: "Since, by this method (Whitehead method) the entire cuff of hemorrhoidal mucosa is removed, it appeals strongly to the surgeon on theoretical grounds, not only as radical, but as the operation of choice."[2]

In addition to the manifest sincerity of purpose and the logic of the plan, there is one point that is probably overlooked by many of the present generation: the "personal equation." It seems that in the old days when they lacked many of our modern advantages of diagnostic and therapeutic aids, personal skill loomed larger as a requisite than it does today. When men could not look through a fluoroscope at lung or stomach, they had to compensate by developing and refining their sense of touch and hearing. It is quite likely that they could listen better with their stethoscopes than we can because they had no other aids. And it is also quite likely that surgeons of those days, including Walter Whitehead, attained great manual dexterity and surgical judgment. The mere fact that Mr. Whitehead excised 139 cancerous tongues with reduced mortality, should vouchsafe his integrity and testify to his skill.[3]

Indeed, it seems quite plausible that this great surgeon was quite sincere and

* Walter Whitehead, F.R.C.S., Ed.; F.R.S. Edin.; Surgeon to the Manchester Royal Infirmary, England; Past President of the British Medical Association; Professor of Clinical Surgery, Victoria University, England.

truthful in his report of 350 cures by his amputative method for advanced hemorrhoids.[1] There is undoubted truth in the opinion of one author who states:

"I think that Whitehead's favorable report is probably attributable to the fact that he did not perform the operation as it is popularly done today. He probably did the operation correctly. Those who attempt to do it according to his description very likely do it incorrectly."[4]

Thus, a new complexion is given to the matter. There is doubt about the description of the so-called "Whitehead operation." The man's integrity should carry some weight; the principles of the operation are in accord with the cardinal principles of surgery; his surgical skill was great. And now, in addition we have something else to think about.

Whitehead performed his operation correctly and obtained uniformly good results; others misinterpreted his description and got failures. Disgust, censure, and invective followed, the ultimate in abuse being voiced by one who attained some notice and some acclaim by coining the term, "Whitehead deformity."

Now why should the failure to attain Whitehead's success be attributed to misinterpretation of Whitehead's directions? Again let me quote from an authority representing an institution that has handled more than 30,000 rectal cases:

"It should be said, in justice to Whitehead, that the very prevalent ectropion of rectal mucosa seen following his operation is due to no fault of his. Had his instructions been understood and followed properly, no such deformity would have developed. For he explicitly stated that after the amputation has been completed, the mucous membrane of the rectum was sutured to 'the free skin margin' which remained after the circular incision had been made at the mucocutaneous juncture. The trouble has arisen as a result of a faulty conception of anorectal anatomy and instead of making the circular incision at the beginning of the operation, at the pectinate line (mucocutaneous junction) the tissues have been cut in a circular manner at or near the anal verge and when the mucosa of the rectum has been sutured to this margin, it has become exposed externally."

In his thorough, conscientious manner, this authority goes on to elaborate why the confusion has arisen:

"Another expression which is often used synonymously with the term pectinate line is Hilton's 'white line.' If Hilton's own statement is to be examined, it will be found that the line to which he referred is synonymous with the intersphincteric line instead and his description alone is sufficient to convince the reader that he was confused . . . . "[5]

If the reader has not already abandoned this article as a result of being confused by the discussion of confusion, he will be convinced of three things: First, that if modern proctologists cannot agree on terminology, what chance did Whitehead have of describing his procedure with precision? Second, the reader will see that there is a plethora of euphoneous, ambiguous, and often meaningless terms (mucocutaneous line, anorectal juncture, white line of Hilton, etc.) Third, he will suspect that the surgical anatomy of the anorectum is vague and wonder if there are really any true surgical landmarks upon which the surgeon can depend for orientation and guidance.

Now the story can be told. Now, we know where and how to find the proper level at which to amputate a prolapsing hemorrhoidal mass and subsequently establish closure. The "denuded verge" of Whitehead takes in too much territory, gives a leeway of interpretation that invites trouble. Whitehead's good results were due to his surgical skill and intuition because the true surgical landmarks that afforded the determination of the "line or level" in question were not revealed until fifty years after Whitehead's death. Our present knowledge of the true surgical land-

marks of anorectal musculature developed after 1936.

That was when Levy produced proof that the conjoined longitudinal muscle interwove with the divisions of the sphincter to form a web.[6] He started something. Prior to that the surgeon was laboring under the delusion that the sphincters were stacked in a vertical line like a stack of doughnuts, a concept as useless as it was false.

The "web concept," on the other hand, shows how, why, and where landmarks are formed and what forms them. And in addition, one can readily see how the branched tubular glands at the base of the anal crypts penetrate the meshes of the web to various depths and, according to their depth of penetration, produce a variety of clinical manifestations. This is to say that when the true arrangement of the anorectal musculature is visualized, most of the rectal surgeon's problems are automatically solved. He sees the mechanism of patholysis; he has precise orientation and guidance by tangible landmarks.

Furthermore, he sees where the "line or level" is to be established in the amputative operation for prolapsing hemorrhoids. "The 'level' should be established midway between two easily palpated landmarks: the intermuscular groove and the puborectalis muscle which separates the rectal ampulla from the anal canal."[7]

Now, to answer the question as to what was wrong with Whitehead's work: The answer is that nothing was wrong with the work of Whitehead himself. The "wrong" was done to the name of this great surgeon by the less skillful ones who were unwilling to take the blame for their own mistakes or mishaps. There is no more justice in dubbing a recurrent inguinal hernia after repair a "Bassini deformity" than in calling the "ectropion of rectal mucosa" following an improper amputative hermorrhoidectomy a "Whitehead deformity."

REFERENCES

1. WHITEHEAD, WALTER: Surgical treatment of hemorrhoids. *Brit. M. J.*, 1: 148–150, 1882.
2. YEOMANS, F. Proctology. P. 166. New York, 1929. D. Appleton & Co.
3. POWERS, D'ARCY. Whitehead's operations. *Brit. J. Surg.*, v 12: 625–629,
4. RANKIN, BARGER and BUIE. The Colon, Rectum, and Anus. P. 656. Philadelphia, 1932. W. B. Saunders Co.
5. BUIE, L. A. Practical Proctology. Pp. 51 and 203. Philadelphia, 1937. W. B. Saunders Co.
6. LEVY, EDWARD. Anorectal musculature. *Am. J. Surg.*, 34: 141, 1936.
7. EATON, CHELSEA. Proctologic postulates from an anatomic standpoint. *Am. J. Surg.*, 58: 64, 1942.

Case Reports

BRODIE'S ABSCESS

TWO CASE REPORTS

LIEUT. JAMES W. DOWNEY AND MAJOR HAROLD E. SIMON
MEDICAL CORPS, ARMY OF THE UNITED STATES

BRODIE'S abscess is a well localized chronic or subacute, non-specific pyogenic abscess, usually involving the juxta-epiphyseal regions of long bones. Although of rather infrequent occurrence, Brodie's abscess is important because it is often overlooked entirely or wrongly diagnosed. Prompt response to treatment makes early diagnosis essential.

LITERATURE

In 1824, Sir Benjamin Brodie[1] treated the first recognized case by amputation of the leg. The patient requested this radical treatment after suffering severe pain for twelve years. Subsequent pathological examination revealed a large, localized, pus filled cavity in the lower portion of the tibia in an otherwise normal leg, which convinced Brodie that such radical treatment was unnecessary and two years later, when a second patient was observed with similar symptoms, he accomplished a cure by trephining the bone. Subsequently, seven patients were conservatively treated by him with recovery in every instance. Brodie[2] described the lesion as follows:

"When the tibia is enlarged, from a deposit of bone externally, when there is excessive pain, such as may be supposed to depend on extreme tension, aggravated at intervals, and these symptoms continue and become aggravated and do not yield to treatment, you may reasonably suspect the existence of abscess in the center of the bone. You are not to suppose that there is no abscess because the pain is not constant, on the contrary, it very often comes on only at intervals, and in one of the cases which I have related there was an intermission of seven or eight months. After it has lasted a number of years, the pain never entirely subsides, still it varies."

Cases were occasionally reported thereafter and Thompson,[3] in 1906, was able to collect 161 cases from the literature. One abscess of the tibia reported by him was so outstanding that the specimen is preserved in the museum of the Royal College of Surgeons of Edinburgh. This abscess had a capacity of more than 500 cc. and communicated externally by a fistulous opening 2.5 cm. in diameter. It is reported that the patient, a sailor, was able to use his limb quite well and would periodically drain the accumulated pus by removing a wooden plug kept in the opening.

Henderson and Simon,[4] in 1924, reported thirteen cases and collected twenty-six additional ones from the literature. Since then, numerous case reports have appeared, including nine by Piquet and Cyssau[5] in 1928 and twelve by Wagner and Hanby[6] in 1938. In all, we have reviewed 340 cases appearing in the literature since Brodie's original article. (Table 1.)

CASE REPORTS

CASE 1. A white female,* aged thirteen years, complained of pain in the left hip of two months' duration. The pain was aching and

* Patient observed in the Surgical Clinic of Harold E. Simon, Birmingham, Ala., prior to his entry into military service.

remittent in character, radiated down the left thigh and was aggravated by walking. One and one-half years previously, she had suffered pain in the same area severe enough to prevent attendance at school for two days; six months and again six weeks prior to admission she had fallen, slightly injuring the left hip. A diagnosis of bone sarcoma had been made elsewhere and amputation advised.

TABLE 1
LOCATION OF BRODIE'S ABSCESS IN 340 CASES COLLECTED FROM THE LITERATURE

	Collected Cases of Thompson	Collected Cases of Henderson and Simon	Collected Cases [24-51] Since 1924, Incl. Our Own	Total
Tibia	(108)	(31)	(74)	(213)
Upper end tibia	63	10	27	100
Middle of tibia	2	1	6	9
Lower end tibia	42	17	41	100
Tibia (portion not stated)	1	3	0	4
Femur	(18)	(3)	(29)	(50)
Upper end femur	0	0	11	11
Middle of femur	0	0	1	1
Lower end femur	18	3	17	38
Humerus	(18)	(2)	(13)	(33)
Upper end humerus	0	0	7	7
Middle of humerus	0	0	3	3
Lower end humerus	0	0	3	3
Humerus (portion stated)	18	2	0	20
Radius	(4)	(1)	(12)	(17)
Upper end radius	0	0	3	3
Middle of radius	0	0	1	1
Lower end radius	0	0	8	8
Radius (portion not stated)	4	1	0	5
Calcaneous	.....	.....	3	3
Fibula, not stated	.....	.....	1	1
Lower fibula	.....	.....	1	1
Ulna (lower)	2	.....	2	4
Patella	.....	.....	2	2
Pubic bone	.....	.....	1	1
3rd L. spinus process	.....	.....	1	1
12th rib	.....	.....	2	2
Metacarpals	.....	.....	2	2
Cuboid	.....	.....	1	1
Scapula	.....	.....	1	1
Not stated	11	2	2	15
Total	161	39	147	347*

* Two patients had three cavities each and three patients had two cavities each.

On examination the patient walked with a limp and there was tenderness over the lateral aspect of the left thigh between the iliac crest and the greater trochanter. There was no enlargement of the hip. Roentgenologic examination on March 18, 1938, revealed a fusiform enlargement of the trochanteric area of the left femur. The bone was of uniformly increased density with complete loss of characteristic bone markings. In the central portion of this swelling was a rarefied area 6 cm. in length and 1¾ cm. in diameter. (Fig. 1.) The laboratory findings were normal except for a leucocytsis of 14,800. Brodie's abscess was diagnosed and the femur explored on March 29, 1938, by a vertical incision below the trochanter. The periosteum showed slight inflammatory change; the bone was extremely hard and thickened and in the central portion of the involved area was a long cavity containing cancellous bone and granulation tissue. The cavity was completely uncovered leaving a saucerized defect; the overlying soft tissue was mobilized into this defect and the wound closed. Microscopic examination of the specimen revealed osteosclerosis and chronic inflammation.

Healing took place by first intention and she remained symptom-free for seven months, at which time pain in the left thigh recurred, but not as severe as previously. The pain was aggravated by walking and did not improve with sulfanilamide therapy and injections of staphylococcus toxoid. Tenderness was again noted over the lateral aspect of the left femur and roentgenologic examination revealed a circumscribed area of decreased density in the center of a fusiform enlargement of the upper end of the bone. There was marked increased density of the surrounding bone. (Fig. 2.) The temperature was normal. Except for a hemoglobin of 63 per cent (Sahli), the laboratory findings were within normal limits.

On December 1, 1938, the upper end of the femur was again explored; there was marked increased density and thickening of the bone and a cavity filled with granulation tissue was present. This cavity was uncovered, thoroughly curetted, the defect saucerized and the wound closed without drainage. Pathological examination revealed cortical bone of increased density with fibrosis of the endosteum.

She was again symptom-free for seven months when pain and limping recurred accompanied by slight swelling of the thigh. Roentgenologic examination on August 21, 1939, revealed persistent thickening of the upper 12 cm. of the femur below the trochanter with two areas of decreased density.

At operation, the bone was again markedly thickened and several areas of granulation tissue were present. The periosteum was retracted and a radical excision of the cavity was carried out; all abnormal bone tissue was

removed leaving only a shell of thickened bone on the medial side. The overlying muscles were sutured and the wound closed without drainage. Pathologic examination revealed fragments of dense cortical bone and masses of spongy red tissue interspersed with fragments of cancellous bone. Staphylococci were recovered from culture. Convalescence was uneventful and symptoms have not recurred.

FIG. 1. Roentgenologic appearance of upper femur in Case 1 before operation, showing fusiform enlargement with marked thickening of the bone and a central cavity.

FIG. 2. Roentgenologic appearance of the femur in Case 1, seven months after operation, showing recurrence of central abscess.

CASE II. A male soldier, aged thirty-eight years, was admitted to the hospital complaining of pain in the right wrist of two weeks' duration. The pain was at first deep-seated and aching in character, but soon became so severe that sedation was necessary to obtain sleep. At the age of twelve years there had been transitory pain and swelling of this wrist which subsided with heat and rest. The previous history was negative except for furunculosis of the neck at eighteen years of age. Typhoid fever, recent infections, and injuries to the involved area were denied.

Examination revealed point tenderness over the distal portion of the dorsal aspect of the right radius with limited and painful motion of the wrist. Roentgenologic examination on February 28, 1943, revealed a fusiform enlargement of the lower end of the right radius with moderate thickening of the surrounding bone and a circumscribed area of rarefaction 1.1 cm. in diameter adjacent to the epiphyseal line. (Fig. 3.)

Brodie's abscess was diagnosed and the distal end of the radius was exposed through a dorsolateral incision and the cavity uncovered. It was lined with granulation tissue and filled with thick, green pus. The cavity was curetted, packed with paraffined gauze and sulfathiazole powder and the hand and forearm incorporated in a cast. Cultures of the pus yielded staphylococcus. Microscopic examination of the bone fragments showed no definite necrosis. The marrow spaces were filled with loose fibrous tissue exhibiting moderate round cell and neutrophilic infiltration. On the thirty-fifth postoperative day, the cast was changed and the gauze removed. Sixty days postoperatively, the second cast was removed. A draining sinus tract persisted and roentgenologic examination revealed a persistent area of rarefaction in

the distal radius surrounded by bone of increased density with a small sequestrum in the center of the cavity. (Fig. 4.) The bone was

Fig. 3.

Fig. 4.

Fig. 3. Roentgenologic findings of Brodie's abscess in Case II, characterized by a fusion enlargement of the lower end of the radius with a circumscribed area of decreased density surrounded by thickened bone.

Fig. 4. Roentgenologic findings in Case II, before second operation; a small sequestrum is present in the center of the cavity.

again explored and the sequestrum removed. Sulfanilamide was placed in the cavity, the wound closed and a cast applied.

Convalescence was uneventful. The wound healed without drainage and when last contacted, one year later, the patient was symptom-free and possessed full function of the wrist.

SYMPTOMS AND FINDINGS

The characteristic complaints of Brodie's abscess are pain and bony enlargement. These may be present for weeks to years before the condition is recognized. Dudley[7] reports a patient who suffered symptoms for twenty years and Choyce[8] reported persistence of the condition for sixty years In the present series, the duration of symptoms was less than one year in thirty-five cases and exceeded one year in eighty-one cases with an average of 6.3 years. Pain is an early and constant symptom and may be mild and intermittent at the onset, becoming progressively more severe with occasional remissions. It is commonly aggravated by activity or atmospheric changes and is usually more severe at night. When mild, the pain is often dull in

character but when severe and constant, it is frequently boring and stabbing in character and referred to the adjacent joint or the entire limb.

Early in the course of the disease, the patient may be unaware of swelling, but bony enlargement becomes a constant finding with the progressive development of the abscess. Limitation of motion of the adjacent joint or interference with function of the entire limb may develop. Effusion into the adjacent joint is not infrequently observed.[9-12]

Systemic reactions are usually mild or absent unless the infection becomes acute, at which time malaise, headache, loss of weight, mild temperature elevation and increased fatigability may appear. Neutrophilic leukocytosis, rarely exceeding 13,000 to 15,000, may develop.

On examination, fusiform swelling involving the entire circumference of the bone is usually present, and localized tenderness is frequently elicited. The soft tissues are characteristically not involved, but occasionally there may be varying degrees of redness, swelling, tissue thickening and rarely localized fluctuation. Spontaneous development of a draining sinus is exceedingly rare. Limitation of motion of the adjacent joint may be present. In the young, shortening of the extremity may occur in rare instances as a result of interference with a normally growing epiphysis. More rarely, lengthening may occur as a result of hyperemia of the epiphyseal region.

The early diagnosis of Brodie's abscess depends upon the roentgenologic findings. The appearance of a small localized area of decreased density usually near the epiphysis of the long bones with slight thickening of the surrounding bone, are characteristic early findings. Later the cavity appears clear cut and varies from .5 to 7 cm. or more in diameter, surrounded by compact bone. The circumference of the bone is increased due to the expanding nature of the lesion. Sequestration, penetration into the joint, or extension toward the diaphysis of the bone are rare. Spontaneous fracture has been observed in only isolated instances.

PATHOLOGY

In the early cases, the abscess tends to be small and the surrounding bone shows relatively no structural changes or at most only slight thickening. The cavity itself is filled with a homogeneous mass of granulation tissue which microscopically shows numerous loops of newly formed blood vessels with leucocytes and tissue cells all in a state of active proliferation.

As the condition progresses, the cavity becomes more distinct and the surrounding bone shows a corresponding increase in its outer circumference. This bone becomes denser and may approach eburnation; the wall of the cavity becomes sharply demarcated and lined by a pseudomembrane of compact granulation tissue. The contents of the cavity are first serous, then purulent. Chronic infection is manifested by lymphocytic and neutrophilic infiltration of the vasculofibrous lining of the cavity.

Because of its frequent proximity to the joint, irritation of the synovial membrane may occur with effusion into the joint space. The typically slow progress of the lesion results in thickening and expansion of the surrounding bone which prevents fistula formation and sequestration. The periosteum tends to become attached to the overlying bone and is increased in thickness, often presenting a grossly laminated appearance.

DIFFERENTIAL DIAGNOSIS

The characteristic symptoms and findings of Brodie's abscess are confirmed by roentgenological studies. The lesion may be mistaken for bone sarcoma and other malignant bone tumors but in these, loss of weight and cachexia appear early and roentgenologic findings and biopsy establish the diagnosis.

Chronic sclerosing osteitis[13] typically involves the medullary portion of the bone

and roentgenologically shows marked thickening and increased density without the fusiform swelling characteristic of Brodie's abscess. Bone cysts can be differentiated by the absence of reaction of the surrounding bone, since here the cavity develops as a result of osseous destruction, frequently with marked thinning of the surrounding bone and without expansion. Tuberculosis of the bone is associated usually with early joint involvement and has more severe localized and generalized reactions. Roentgenologic findings are characteristic. Syphilitic osteitis and periosteitis are likewise diagnosed by characteristic roentgenologic findings and serological reaction and by prompt response to specific therapy.

Other conditions which may be confused with Brodie's abscess are sciatica, bursitis, scurvy, hemarthrosis, rheumatic fever and arthritis.

ETIOLOGY

Brodie's abscess occurs predominantly in males. In 134 collected cases in which sex was mentioned, the ratio was 97 males to 37 females. In 133 cases in which the age was mentioned, 119 cases were under, and only fourteen were over, the age of forty years. Forty-seven were between the ages of eleven and twenty; thirty-six between the ages of twenty-one and thirty; and twenty-one were between the ages of thirty-one and forty. (Table II.) The youngest patient in the collected series was a boy of one year and the oldest was a man of sixty-three years. The greater susceptibility of the male and its occurrence most frequently during the age of greatest physical activity suggest trauma as a contributing factor. However, a history of trauma even when present was frequently indefinite, occurred months and years prior to the onset of the symptoms and its significance is questionable.

Table II

Age incidence of Brodie's abscess in 140 collected cases

Years	No. of Cases
1–10	15
11–20	47
21–30	36
31–40	21
41–50	10
51–60	3
61–70	1
Not stated	7
Total	140

The lesion occurred in the tibia in 213 out of 332 instances in which location was mentioned, equally divided between its upper and lower extremities. The distal and proximal ends of the femur were involved next in frequency and then the humerus and radius and rarely the calcaneous[14,15] fibula, ulna, scapula,[16] patella,[17] public bone,[18] spinus processes,[19] ribs,[20] cuboid, and the metacarpals. Localization in the mid-portion of a long bone is rare and was observed only nine times in the tibia, once in the femur, three times in the humerus and twice in the radius. The abscess cavities are rarely multiple; two were observed in one patient in three instances,[21,5] and two patients each presented three distinct cavities.[20,5] (Table I.)

Brodie's abscess has been diagnosed frequently when osteomyelitis existed previously in the same location. Thompson found such a history in 122 of his 145 collected cases. Such cases were not included by us as true Brodie's abscesses, but considered residual infection secondary to osteomyelitis. Primary solitary abscesses which co-existed with or followed osteomyelitis but in a different location have been included; there were fourteen cases of this type.

The frequency of acute infections preceding Brodie's abscess is striking, particularly because the organism recovered from the abscess was, in many instances, identical with the organism which caused the preceding infection. In ten instances, the abscess was preceded by typhoid fever and in eight of these *Bacillus typhosus* was recovered from the abscess. In one instance,[22] there was a history of paratyphoid fever two months prior to the onset of

symptoms and Salmonella paratyphosus A was recovered from the abscess. *Escherichia coli* was isolated from one abscess which followed amoebic dysentery. In seven instances acute otitis media preceded the onset of the symptoms and from all of these abscesses staphylococci were recovered. Superficial abscesses of the skin preceded the onset in eight cases and in six of these staphylococus was found. In eleven instances there was a history of influenza or "la grippe" preceding the appearance of the abscess and in four, staphylococci were recovered. Of the fourteen cases with a previous history of osteomyelitis elsewhere, staphylococci were recovered in nine instances, hemolytic streptococci in two instances and cultures not reported or negative in three instances. (Table III.)

TABLE III
BACTERIOLOGICAL FINDINGS IN 140 CASES OF BRODIE'S ABSCESS

Staphylococcus—aureus	52
Staphylococcus	21
Staphylococcus—hemolyticus	3
Staphylococcus—albus	4
Staphylococcus—citrus	2
Typhoid bacillus	7
Paratyphoid bacillus A	1
Paratyphoid bacillus B	1
Streptococcus	2
Streptococcus—non-hemolyticus	2
Streptococcus—hemolyticus	1
Pneumococcus	2
Colon bacillus	1
Negative culture	7
Not reported	34
Total	140

The predilection of the abscess for the extremities of long bones, in areas which are especially vascular, the greater susceptibility of bones and portions of bones most exposed to trauma, the similarity between the bacteria recovered from the cavity and that of the preceding infection, in some instances definitely hematogenous in character, strongly supports Ogilvie's[23] theory that "the primary lesion is a juxta-epiphyseal strain, a partial injury at the very vascular area plus general lowered resistance in the presence of foci elsewhere."

TREATMENT

Brodie's first patient was treated by amputation. Subsequently, patients have been treated by trephining, plombage or filling of the cavity with paraffin, oils or antiseptic pastes, unroofing of the cavity and obliteration with chips of bone, grafts of muscle or fat, with primary closure or prolonged packing with gauze according to the Orr method. Vaccines as an aid to control infection have been tried with questionable benefit. Palliative measures such as rest, heat, diathermy and application of casts resulted in only temporary relief of symptoms.

The present methods of treatment consist of complete excision of the cavity with saucerization of the bone defect and primary closure after obliteration of the cavity by mobilization of the adjacent soft tissue. The local use of sulfonamides supplemented in many instances by their systemic administration preoperatively, postoperatively, or both, is indicated. Rarely, as in the presence of a draining fistula or when a more acute process exists, packing of the wound with gauze for varying periods of time with secondary closure, as was done in the two reported cases, may be indicated. Application of a cast postoperatively for a period of two to three weeks is indicated to accomplish rest and provide support for a bone which may have been weakened by surgical procedures.

PROGNOSIS

The prognosis is excellent. Reoperation may be necessary for persistent draining sinus, sequestrum formation, or when there is extensive chronic infection of the surrounding bone. In the absence of these conditions there is little or no tendency to recurrence. Amputation is never necessary and fatal termination has not been observed in any of the 340 cases reviewed.

SUMMARY AND CONCLUSIONS

Two cases of Brodie's abscess are reported and 340 cases reviewed from the literature.

The etiology, pathology, symptoms, findings and treatment are discussed. The importance of early diagnosis and differentiation from other bone lesions is stressed. The disease is benign and probably of hematogenous origin and trauma is considered to be only of localizing importance.

Surgical intervention with complete removal of the abscess wall, saucerization of the wound and obliteration of the defect are essential to accomplish cure; the local and general use of sulfonamides is beneficial. Primary closure of the wound is usually preferable to drainage and secondary closure.

REFERENCES

1. BRODIE, B. Lecture on abscess of the tibia. *London Med. Gaz.*, 36: 1399–1403, 1845; Pathological and Surgical Observations on the Diseases of the Joints, London, 1836. Longman. Works of Sir Benjamin Brodie, London, 2: 311 and 3: 403 (Quoted by Ogilvie Page 388) 1865; Biography. *Brit. J. Surg.*, 6: 157–159, 1918–1919.
2. BRODIE, B. Brodie's tumor and Brodie's abscess, eponyms. *Brit. J. Surg.*, 9: 334–337, 1922.
3. THOMPSON, A. Observations on the circumscribed abscess of bone (Brodie's abscess). *Edinburgh M. J.*, 19: 297–309, 1906.
4. HENDERSON, MELVIN S. and SIMON, HAROLD E. Brodie's abscess. *Arch. Surg.*, 9: 504–515, 1924.
5. PIQUET, JOHN and CYSSAU, G. Les abces chroniques primitifs des os. *Rev. de chir.*, 66: 647–707, 1928.
6. WAGNER, L. C. and HANBY, JOHN ESTES. Brodie's abscess; pain distribution, occurrence and diagnosis. *Am. J. Surg.*, 39: 135–144, 1938.
7. DUDLEY, G. S. Brodie's abscess of tibia. *Surg. Clin. North America*, 8: 411–413, 1928.
8. CHOYCE, C. C. A System of Surgery. 2nd ed. London, P. H. Hoeber, 3: 743–745, 1923.
9. GREGOIRE, Abces intra-osseux du tibia. Vaccination. Trepanation. Obliteration de la cavite. Reunion per primam. *Bull. Soc. Chir.*, 1921. Quoted by Piquet and Cyssau.[5]
10. BARTOLI, F. De l'ascesso cronico delle ossa (Ascesso di Brodie). *Chir. d. Org. di Movimento*, 17: 193–200, 1932.
11. KMENT, H. Diagnostik und Behandlung chronischer Knochenabszesse. *Beitr. z. klin. Chir.*, 155: 129–145, 1932.
12. RODRIQUEZ, M. CIEZA. Surgical treatment of Brodie's abscess. *Semana med.*, 2: 1170–1173, 1929.
13. HENDERSON, M. S. Chronic sclerosing osteitis. *J. A. M. A.*, 82: 945–949, 1924.
14. MEYER-BORSTEL, H. Der Brodiesche Knochenabscess. *Chirurg.*, 3: 560–565, 1931.
15. LEWIS, RAYMOND W. Cases of nonspecific bone infection with unusual or obscure features. *Am. J. Roentgenol.*, 46: 659–666, 1941.
16. GROFF, J. E. and GHORMLEY, R. K. Brodie's abscess of scapula: report of a case. *Proc. Staff Meet., Mayo Clin.*, 11: 55–57, 1936.
17. MARIUPOLSKY, A. Brodie's chronic bone abscess. *Vestnik. roentgen. i Radiol.*, 8: 455–462, 1930.
18. PAINTER, CHARLES F. Brodie's abscess in pelvic bone. *New England J. Med.*, 202: 585–586, 1930.
19. WHEAT, HARRY R. and HATHAWAY, L. E., JR. Brodie's abscess of spinous process. *New England J. Med.*, 209: 243–244, 1933.
20. ORTIZ, A. F., JR. Absceso de Brodie con tres localizationes. *Arch. Argent. de pediat.*, 8: 366–373, 1937.
21. CALLAWAY, E. Multiple bone abscesses: report of case. *J. M. Georgia*, 24: 73, 1935.
22. BARCO, P. Osteite par fievre paratyphoide. *Minerva Medica*, 7: 977–984, 1927. Quoted by Piquet and Cyssau.[5]
23. OGILVIE, W. H. Central abscess of bone. *Clin. J.*, 51: 385–389, 1922.
24. MÖLLER, H. (KOLBERG). Über den Brodie—Abszess mit zwei Fällen als Beitrag zur Kasuistik. *Med. Welt.*, 12: 1209–1212, 1938.
25. BRAILSFORD, JAMES F. Brodie's abscess and its differential diagnosis. *Brit. M. J.*, 2: 119–123, 1938.
26. RABBONI, DOTT F. Su un caso di ascesso cronico centrale del radio. *Chir. d. Org. di Movimento*, 23: 134–140, 1937.
27. WAGNER, L. C. Chronic bone abscesses (Brodie) simulating symptoms of arthritis. *M. Clin. North America*, 21: 1763–1769, 1937.
28. MARSBURY, WILLIAM B. and PECKHAM, HENRY L. Brodie's abscess of radius due to typhoid; report of case. *J. A. M. A.*, 107: 1284–1286, 1936.
29. ALBEE, F. H., HOSKINS, W. H. and COLLINS, C. Bacteriophage treatment of typhoid fever carrier with bone abscess. *Am. J. Surg.*, 33: 317–320, 1936.
30. TEMPLETON, W. L. Brodie's abscess in head of radius. *Brit. M. J.*, 1: 841, 1936.
31. DESPONTIN, AUGUSTO E. Absceso de Brodie. *Semana med.*, 2: 558–569, 1934.
32. EVANS, A. P. Brodie's abscess; case report. *J. M. A Georgia*, 23: 344–348, 1934.
33. MARIANI, M. Ascesso cronico centrale dell'osso. *Chir. d. Org. di Movimento*, 17: 365–373, 1932.
34. PUENTE, DE LA JOSE MANUEL. Brodie's abscess, report of three cases. *Clin. y. lab.*, 23: 1025–1030, 1933.
35. RAHMAN, M. A. and MANGALIK, V. S. A case of Brodie's abscess. *Indian M. Gaz.*, 67: 627–628, 1932.
36. ARNOLD, W. Über Chronisch—osteomyelitische, insbesondere gelenknabe Herde, sog. Brodiesche Knochenabszesse. *Med. Welt*, 6: 1015–1018, 1932.
37. DELREZ, L. Abcés osseux dits "de Brodie," *Liege med.*, 20: 797–802, 1932.
38. STEINSLEGER, MARCUS. Absceso de Brodie. *Rev. med. del Rosario*, 20: 521–527, 1930.
39. FRIDMANAS, J. Brodie's abscess. *Medicina Kaunas*, 22: 97–103, 1941.

40. Codino, Santiago. A proposito de absceso de Brodie. *Rev. med. del Rosario*, 20: 527–529, 1930.
41. Romani, A. Due casi di ascesso centrale dell'osso (ascesso di Brodie). *Cbir. d. Org. di Movimento*, 15: 347–354, 1930.
42. Donovan, R. E. Sobre abscessos de Brodie. *Bol. y trab. de la Soc. de cir. de Buenos Aires*, 12: 345–356, 1928.
43. Sacco, A. and de Nicola, C. Absceso de Brodie. *Bol. y. trab. de la Soc. de cir. de Buenos Aires*, 12: 326–331, 1928.
44. Rogers, Frank E. Brodie's abscess. *Colorado Med.*, 25: 205–207, 1928.
45. Wilenski, A. O. Chronic abscess of bone (Brodie). *Am. J. Surg.*, 5: 455–459, 1928.
46. Owen, Will B. Solitary pyogenic abscesses (Brodie's) of long bones. *South. M. J.*, 20: 546–550, 1927.
47. Brunner, A. Zur Kenntnis de Brodie' schen Knochenabszesses. *Schweiz. med. Wchnschr.*, 59: 1265–1266, 1929.
48. Zeno, A. A proposito de abscessos Brodie. *Bol. y trab. de la Soc. de cir. de Buenos Aires*, 12: 375–379, 1928.
49. Toumey, James W. Sulfathiazole in chronic osteomyelitis. *Surgery*, 14: 531–540, 1943.
50. Berman, H. A. Brodie's abscess: report of case with negative x-ray findings. *Med. Rec.*, 152: 206–207, 1940.
51. Brodie, B. C. Brodie's abscess: Account of some cases of chronic abscess of tibia. *M. Classics*, 2: 900–906, 1938.

Chronic osteoperiostitis usually begins as a periostitis, involving by extension the haversian canals and medulla, and producing a general sclerosis and thickening of the bone. It may be (a) diffuse, or (b) local, and may follow trauma, rheumatism or syphilis.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

CONGENITAL EVENTRATION OF THE DIAPHRAGM

SURGICAL MANAGEMENT

J. DEWEY BISGARD, M.D. AND GEORGE E. ROBERTSON, M.D.
OMAHA, NEBRASKA

A CASE of eventration of the diaphragm in an infant which was cured by operation is reported because, (1) the writers are unable to find a report of a previous attempt to treat this condition in an infant by operation and (2) they suspect that some of the deaths in the newborns which are attributed to other causes of cyanosis and dyspnea are in reality the result of unrecognized congenital eventration, which, as in our case, have prospect of surgical cure.

Eventration of the diaphragm may be defined as an abnormally high or elevated position of one leaf of the diaphragm as a result of paralysis, aplasia or atrophy of the muscle fibers but with no break in the continuity of the leaf. Its unbroken continuity differentiates it from diaphragmatic hernia. Admitted by all authors an inappropriate term, eventration has been established by general use and the lack of a better name. The condition has been observed in people of all ages and, although

FIG. 1. Preoperative film. The right diaphragm is elevated to the level of the posterior portion of the fifth rib and the heart and mediastinum are displaced to the left. The area of cardiac dullness extends to the left costal margin with only a small segment of unobscured lung in the left costal-phrenic sinus. The inferior margin of the liver is above the eleventh rib.

this paper is concerned with the problem in infants, it is necessary to refer to subject matter which deals with the subject as a whole.

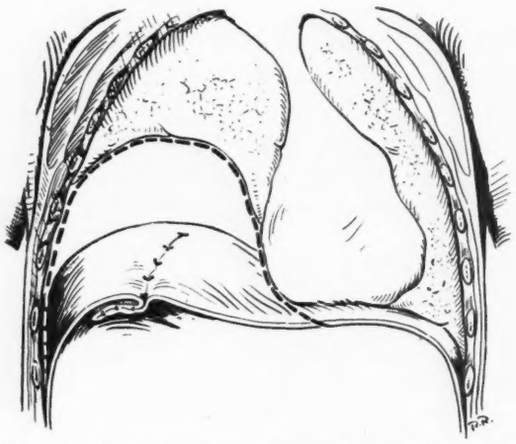


Fig. 2. Diagrammatic representation of the position of the diaphragm (dotted line) and the resultant distortion of the intrathoracic viscera. This is also illustrated in the procedure used in the writer's case. Shortening was accomplished by plication with three superimposed rows of interrupted mattress sutures through an intrathoracic approach.

Bibliographers have credited Petit with the first description of the condition. A case report with postmortem findings appeared in the posthumous edition of his work published in 1774. Infrequently thereafter, isolated cases were reported and in 1913 Bergman reviewed the literature to that date and collected thirty-one cases. Three years later Bayne-Jones reported a collection of forty-five cases including one of his own. In 1921, Korns was able to assemble sixty-five cases and in the most recent collection Reed and Borden, in 1935, reported 183 cases.

Most of the reported cases were adults and it is probable that in most of them the lesion was acquired. A few were incidental findings and presumably caused no symptoms. The remaining cases presented a variety of symptoms which fall into four general groups: (1) gastric, (2) cardiac, (3) pulmonary and (4) pleuropulmonary.

If the number of case reports is a criterion, eventration in infants is indeed a rarity. In his review of the literature up to 1916 Bayne-Jones collected three cases: a fetus, a newborn, one day old, and an infant of three months. In each instance the diagnosis was made at postmortem examination. In the eighty-three cases collected from the literature from 1921 to 1935 by Reed and Borden there were only five infants. From 1935 to 1945, at least nine additional cases in infants have been reported including our case. Undoubtedly these figures give a very inaccurate conception of the incidence. In addition to the unreported cases it is very probable that some of the deaths in infants which have been attributed to other causes of cyanosis and dyspnea have in reality resulted from eventration.

The writers' case was unusual in that the right half of the diaphragm was involved. Of the 183 cases collected by Reed and Borden only eighteen were on the right side.

The symptoms in the infants, when recorded, were cyanosis and dyspnea as in our case.

At postmortem examination the elevated half of the diaphragm has presented varying degrees of atrophy; in the extreme a very thin fibrous membrane was present with complete absence of muscle fibers. Not infrequently there are associated maldevelopments of the lung, heart or liver, failure of intestinal rotation or unassociated congenital deformities as cleft palate.

In the series of 183 cases reviewed by Reed and Borden direct operative attack upon the diaphragm was done in only four cases. Reports of two additional cases were found in the literature which has accumulated since 1935. In all cases the diaphragm was lowered by shortening, in one case by excision of a segment and in five by plication. One patient was plicated from the abdominal side, the others from above through an intrathoracic exposure. One died three days after operation and the others obtained partial or complete relief of symptoms. The ages of these patients varied from ten to forty-four years.

So far as we were able to ascertain from a careful review of the available literature,

our case is not only the first recorded instance of a surgical cure of this condition in an infant but also the only record of operative intervention in a case in this age group.

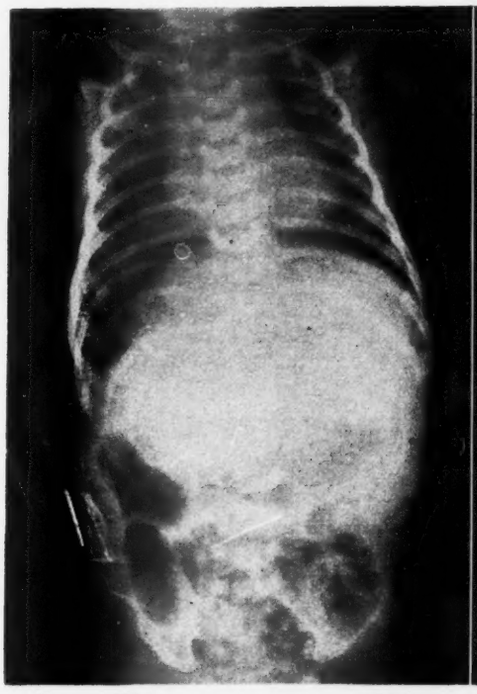


Fig. 3. This roentgenogram made immediately following operation shows the right diaphragm lowered to a position below the left with complete aeration of both lungs and normal intrathoracic relations. The inferior border of the liver is several centimeters below the twelfth rib.

Fig. 4. At the time of dismissal from the hospital, ten days after operation, the lowered position of the right diaphragm was still well retained.

CASE REPORT

Baby W., a male infant six weeks old, was brought to the Bishop Clarkson Memorial Hospital in an improvised oxygen chamber. He was born at full term without operative assistance and appeared normal at birth. On about the tenth day after birth the mother became impressed that respiration was somewhat labored and that cyanosis developed when the infant cried. Feeding became progressively more difficult and he failed to gain weight.

By the fifth week after birth the dyspnea and cyanosis had increased to such an alarming degree that it was necessary to administer oxygen. The father, who is an automobile mechanic in a rural community, fashioned a very satisfactory oxygen tent with the help of the family physician. Although the tent made survival possible there was no improvement in the infant's condition after one week so he was brought to the hospital.

Examination showed a well developed but poorly nourished infant of six weeks showing moderate dyspnea and rather marked cyanosis both of which became very marked with crying and exertion. The right side of the chest moved less than the left and there was lateral retraction with inspiration, also obvious use of the accessory muscles of respiration. There was dullness to percussion and absence of breath sounds below the level of the second rib anteriorly on the right side and in the upper two-thirds of the left chest. The liver was not palpable but the spleen extended 4 cm. below the left costal margin.

The weight was six pounds and fifteen ounces, the temperature 97.2°F., the urine negative, the blood hemoglobin 12.7 Gm. and white blood cells 24,800 with 55 per cent segmented, 20 per cent staff forms, 5 per cent monocytes, 2 per cent eosinophils and 18 per cent lymphocytes.

An *x*-ray film of the chest and abdomen (Fig. 1) showed the right diaphragm elevated to the level of the fourth rib posteriorly. There

was increased density of the right lung, probably from compression and an enlarged heart shadow which was displaced to the left to the extent that it was in contact with the left costal border. Evidence of aeration of the left lung was apparent at the inferior angle only. The liver shadow was displaced upward with its lower border above the costal margin.

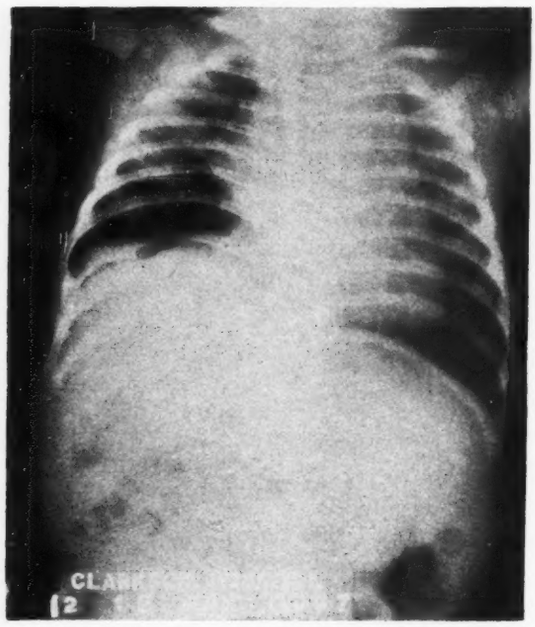


FIG. 5. This roentgenogram made five months following operation shows the right diaphragm at the level of the ninth rib, one interspace higher than the left, presumably indicating that some giving way or relaxation has taken place. The writers are unable to explain the wedge-shaped shadow extending out from the right hilus and the broadened area of supracardiac density; possibly thymus. Note that the eighth and ninth ribs have become broader and fused as a result of the operative trauma.

A diagnosis of either eventration or hernia of the right diaphragm was made and surgical exploration undertaken July 29, 1944. Oxygen was administered with positive pressure through a mask in a closed system and the skin and underlying tissues of the right ninth intercostal space infiltrated with 0.5 per cent novocaine solution. Through this interspace the pleural cavity was opened and adequate exposure obtained with a small rib spreader.

The right diaphragm was intact throughout; that is, there was no break in its continuity. Its apex extended to the second rib anteriorly. Its excursion, though almost negligible, was not paradoxical. Except for pallor it appeared to be fairly normal and obviously it consisted of muscle. On casual observation there was discerned no abnormality of the right lung.

The diaphragm was shortened and brought down to the level of the tenth rib by plication with three superimposed rows of interrupted mattress sutures of silk extending diagonally from the costal attachment in the region of the nipple line posteromesially to the aperature for the vena cava as illustrated in Figure 2. The pleat was turned downward between the diaphragm and liver. The chest wall was closed with pericostal sutures and silk was used in the muscles and skin.

There was complete relief of dyspnea and cyanosis immediately following operation and from then until the time of this report (seven months after operation) respirations have continued to be normal. Also in every other respect the infant appears to be normal and is growing and gaining weight at a normal rate.

Roentgenograms of the chest immediately following operation and at periods subsequently are illustrated in Figures 3, 4 and 5. It will be observed that with the return of the diaphragm to its normal position the intrathoracic organs have likewise resumed their normal positions and both lungs are completely aerated. In the last roentgenogram the right diaphragm is one interspace higher than the left.

COMMENT

It is probable that the writers' case was more amenable to surgical therapy than most cases because the diaphragm contained muscle and had considerable substance in which the sutures were well retained against tension. Much less might be expected of cases in which the diaphragm is a very thin fibrous membrane as has been revealed in a few instances at postmortem examination.

CONCLUSIONS

1. A successful operation and an apparent cure of eventration of the right diaphragm in an infant is reported.

2. As judged from reported cases, it is a relatively rare condition in infancy. The writers believe that some infant deaths result from unrecognized eventration of the diaphragm.

REFERENCES

1. Bayne-Jones, S. *Arch. Int. Med.*, 17: 221, 1916.
2. Bergman, J. *Ergebu. d. inn. Med. u. Kinderh.*, 12: 327, 1913.
3. Chaudhuri, K. C. and Ready, D. V. X. *Indian J. Pediat.*, 7: 1, 1940.
4. Clarke, T. W., Powers, M. T. and Wilson, J. R. *Arch. Pediat.*, 52: 798, 1935.
5. Cosack, G. and Weinbeck, J. *Monatschr. f. Kinderh.*, 70: 161, 1937.
6. Feldman, L., Trace, I. M. and Kaplan, M. I. *Ann. Int. Med.*, 9: 62, 1935.
7. Haase, H. *Wien. klin. Wchnschr.*, 16: 193, 1913.
8. Jaubert de Beaujeri A. *J. de radiol. et d. electrol.*, 21: 123, 1937.
9. Koester, F. *Röntgenpraxis*, 7: 311, 1935.
10. Korns, H. M. *Arch. Int. Med.*, 28: 192, 1921.
11. Landon, J. F. *J. Pediat.*, 8: 593, 1936.
12. Landon, J. F. *Am. J. Dis. Child.*, 50: 284, 1935.
13. Lerche, W. *Surg., Gynec. & Obst.*, 34: 244, 1922.
14. Meckel. Cited by Zwauzinger, H. Inaug. Dissert., Halle, 1819.
15. Nicholas, F. G. and Nussbrecher, A. M. *Lancet*, 2: 611, 1935.
16. Pyl, J. T. *Aufsatze u. Beobacht. a. d. ger. Med.*, 5: 29, 1784.
17. Sakula, J. *Proc. Roy. Soc. Med.*, 33: 629, 1940.
18. Sante, L. R. *Am. J. Roentgenol.*, 44: 350, 1940.
19. Whitmore, O. S. and Kablstrom, S. C. *New York State J. Med.*, 42: 1587, 1942.
20. Yakhuina, R. S. *Klin. Med.*, 13: 1724, 1935.

Umbilical endometriosis presents in the form of small nodules which may, when they approach the surface or when the abdominal wall is very thin, be of blush hue. They increase in size at the menstrual periods, when they become tender and painful. They sometimes break through the skin, with periodic external bleeding.

From "Textbook of Gynecology" by Emil Novak (The Williams & Wilkins Company).

CRIMINAL ABORTION

THREE CASE REPORTS

THEODORE CIANFRANI, M.D.
Associate in Gynecology, Graduate School of Medicine, University of Pennsylvania
PHILADELPHIA, PENNSYLVANIA

WHEN we realize that there are over half a million abortions each year in the United States with more than 8,000 deaths, or 1.2 per 100 abortions, with a marked increase in the last twenty-five years, and that criminal abortions make up from 70 to 80 per cent of these cases, it is remarkable that we do not have more instances of foreign bodies in the uterus, and especially in the peritoneal cavity as a result of these attempts. They present serious problems in diagnosis and a grave responsibility in their management; yet comparatively few reports of such cases with their attendant serious consequences have appeared in the recent literature. Most of the reviews have been on the social and statistical aspect of abortions.

Quite a few years ago Professor Lewis in his book "Die Fruchtabtreibung durch Gifte und andere Mittel" recorded a vast literature on the abortion problem. Katz, in 1922, collected and reported fifty-four cases of criminal abortions with the passage of the instruments used into the peritoneal cavity. J. N. M. Ross and P. D. McLellan, in the Lancet of June 13, 1942, report a foreign body in the abdomen that migrated to the rectus muscle near the liver, following a penetration of the abdomen in a criminal abortion. A. H. Kanter reported a case in the Ohio State Medical Journal of November, 1943, somewhat similar to our second case.

Because of the meagerness of reports of such cases in recent years, we believed it appropriate to report these three cases:

CASE REPORTS

CASE 1. The first case is a young woman, age twenty-two years, who was admitted to my service at St. Agnes Hospital with the chief complaint of vaginal bleeding and suprapubic pain. Because she thought there was "something like a clot in her womb," she used a pair of eyebrow tweezers to remove it, during which the tweezer disappeared. (The patient's story changed so often that we considered it absolutely unreliable). She said her last period was three weeks ago (this was not true). Her temperature on admission was 99.2°F.

Examination showed a patient of normal development but nervous and mentally distressed. Tenderness was present over the suprapubic region. The uterus was the size of a three months' pregnancy, the external os was slightly patulous with moderate bleeding.

X-ray of the abdomen was taken; it showed the tweezer with the open end pointing cephalad.

Treatment consisted of sulfadiazine intravenously, sedation and exploration of the uterus.

Operation was done seven hours after she inserted the tweezer. Under gas anesthesia pelvic examination revealed a soft uterus about the size of a three months' pregnancy with the external os patulous and a moderate ooze of blood. The tweezer was palpated near the cervix; this was grasped with a clamp and removed. A small fragment of tissue, which was uterine content, was taken for examination. No drains were used. There was no abnormal bleeding.

The pathologic report showed chorionic villi, syncitial cells and infected blood clots.

Misinterpretation of the *x*-ray picture almost led to a serious accident in removing the tweezer. As seen on the *x*-ray the open end was directed cephalad, from which we assumed that this open end pointed toward the fundus, and the closed end toward the cervix. It should have been easy, therefore, to grasp the closed end and pull it out of the uterus, the blades would thus be compressed in its passage through the cervix. Fortunately, however, after the pal-

pated end of the tweezer was grasped by a clamp and traction was begun we saw that one of the prongs and not the joined end had been grasped. Had this traction been continued the other prong would have been pulled through the uterine wall. This was obviated by closing the tweezer before removing it.

Fig. 1. Case 1. Tweezer in uterus.

In spite of our warnings of the possibility of infection and hemorrhage, this patient left the hospital eight hours after the removal of the tweezer, with a temperature sharply elevated. A number of days later she entered another hospital with a septic abortion, but eventually recovered.

Case II. This second case is that of a woman, age thirty-four, admitted to the service of Dr. William R. Nicholson at the Graduate Hospital, with the chief complaint of a glass rod in her vagina. She said that she began to menstruate two days ago and because she was out of tampons she decided to use cotton, packing it into the vagina with a glass cocktail stirring rod. The rod accidentally slipped up into her vagina and she was unable to find it. She went to work, but later she became so frightened that she decided to come to the hospital. She said she could definitely feel the rod when she sat down. She felt no pain at any time.

Examination showed vaginal bleeding less in amount than a normal period; the uterus was acutely retroflexed. A pencil like object could be felt extending from the right iliac crest to the posterior cul-de-sac. It was movable and could be felt in its entirety. We could not

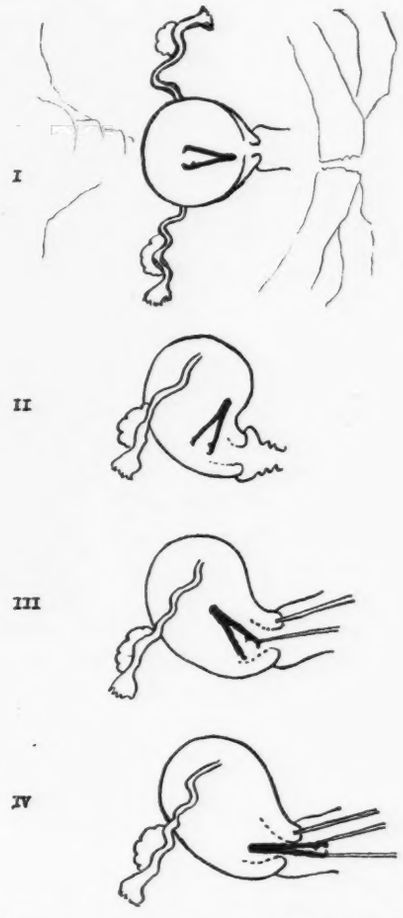


Fig. 2. I, Top view; open end of tweezer points cephalad; this is in relation to bony pelvis. (*X*-ray—same view.) II, Side view; although open end points cephalad, it is directed toward the cervix rather than the fundus. III, Side view; tenaculum on anterior lip; traction has increased the cervicocorporeal angle so that prong of open end is brought into close relation to internal os. A long hemostat is used to grasp prong; pull on this revealed its identity (open end). Continued traction would have pulled other prong through wall. IV. Side view; other prong also grasped with long hemostat, both blades compressed, tweezer removed.

locate the point of entrance. Rectal examination with a scope was negative. (There was the possibility that this rod might have entered the bowel through the rectum, though remote because of its location on right side). The abdomen was normal except that one end of the rod could be palpated.

X-ray was taken. A rod in the left pelvic cavity, which probably perforated the left vaginal wall, was reported.

Her temperature was 99.2°F., red blood count 3,000,000, and white blood count 10,050. Sulfadiazine was given intravenously.

An abdominal operation was done six hours after admission. A small abdominal mid-line incision was made. The blue crystal cocktail stirring glass rod six inches long was found free in the peritoneal cavity, its upper end near the liver. There was no blood in the peritoneal cavity. The uterus was acutely retroflexed, about four to six weeks pregnant. The site of perforation was found on the anterior wall of uterus; it was 1 cm. in size, covered with a bluish clumped exudate with early signs of healing. The omentum was free; no other injuries were found. A few mattress sutures were used to reinforce the rent (which was already sealed).

Five days after operation a Friedmann Test was done and found to be positive. Her recovery was uneventful. The highest temperature was 101°F. by the second day and normal by the fifth day. She was discharged on the fourteenth day.

Fig. 3. Case 11. Glass rod in abdomen.

This woman suffered no pain and developed neither hemorrhage nor infection. The glass cocktail stirring rod may have been procured from a cocktail just prior to its use, so possibly sterile therefrom. The glass rod was made of blue glass, pigmented; this made the *x*-ray picture possible (it might otherwise not have cast a shadow).

It is interesting to note the co-incidental finding of an acute retroflexion so that the rod went through the anterior wall of the uterus in its lower segment. This part of the uterus was very soft and thin because of the pregnancy. In its passage the glass rod missed the growing embryo; the sac itself evidently was unharmed. Only a slight bloody stain was noted per vagina.

The patient did not bleed vaginally postoperatively; a Friedmann Test was done five days later which was positive. The size of the uterus was unchanged upon discharge, so she was told that very likely she would continue with her pregnancy, to which she replied that she was very happy this was so. However, four

months later examination showed the uterus to be small and almost normal again. Of course she denied having had a further abortion or any history of bleeding or pain after she left the hospital, all of which, however, is questionable.

Fig. 4. Case III. Glass rod with upper end free in peritoneal cavity, its lower end in wall of uterus.

Case III. With the permission of Dr. Neese and Dr. Oaks of the Graduate Hospital, I wish to present the *x*-ray picture and a brief resumé of a case in which the patient was operated upon by them at the American Stomach Hospital, because it apes Case II very closely. This patient also used a cocktail glass stirring rod to abort herself, of a larger size, however, 20 cm. long. Except for moderate vaginal bleeding and mild abdominal cramps, she likewise exhibited very little in the way of internal hemorrhage or infection, or even peritoneal irritation. Her cramps were probably due to the expulsive effort of the uterus, because the lower end of the rod was still held by the fundal wall while its upper end was found at the base of the liver. In Case II the rod was shorter, 10 cm. in length, and entirely free in the abdomen. It may be of interest to note that in both these cases the rods found their way toward the undersurface of the liver.

This patient made an uneventful recovery and left the hospital still pregnant. She was seen a few months later with a pregnancy that was progressing normally, but unfortunately the ultimate outcome of her pregnancy is not known because she registered elsewhere for her delivery. So far attempts to locate her have failed.

These cases show to what length some women will go to rid themselves of undesired pregnancies. The methods used are evidence of the desperate state of mind of these women who so willingly face self-destruction in their efforts to terminate a pregnancy. Many women who wish to have no more children train themselves to feel for the location of the cervical orifice and without any effort toward sterilization

slip instruments within the cervical canal and successfully terminate their pregnancies.

The trend in modern times has been instrumental interference by a trained abortionist. The intra-uterine injection of soap solution or glycerine seems to be the preferred method, despite the danger of infection, cauterizing action and risk of pushing some of this solution through the tubes into the abdomen. Air embolism from these syringe paste methods is a possibility.

It is not unusual to find a tubal pregnancy instead of an intra-uterine pregnancy in cases of attempted abortion, and it is ironic that often women go through severe unnecessary torture and expense when they are not pregnant at all.

Perforation of the uterus is the commonest accident of illegal abortion with infection usually added. In perforations from criminal abortions, the sooner a laparotomy is done, the better, because of potential infection. The amount of surgery, such as the mere sewing of the rent in the uterus, drainage or hysterectomy, depends on how soon after the accident the operation is done and how much injury there is to the viscera.

If the foreign body is not removed, it becomes encapsulated after the peritonitis has subsided. Months or years of localized infection may be the patient's lot. When recovered from perforation with or without operative intervention the sequelae may effect the general health by residual chronic pelvic infection. It is not unusual to find a uterine wound that shows imperfect healing, and rupture of the uterus may occur in a subsequent pregnancy.

SUMMARY AND CONCLUSIONS

The first case in which an eyebrow tweezer was used in an attempted criminal abortion emphasizes the need of thorough study of *x*-rays to ascertain the direction of such a double-pronged sharp instrument, so vitally important in its removal. A mere flat film is not all revealing because of the variation in position of the uterus. The relationship of a foreign body to the uterus is the important factor and not its relation to the bony pelvis, such as a flat plate would give us.

The other two cases in which attempted criminal abortions by glass cocktail stirring rods resulted in perforation of the uterus, passage of the glass rod into the abdomen and no interruption of the pregnancy, illustrate (1) the ease with which foreign bodies can perforate a uterus without unduly alarming a patient as from pain or hemorrhage; (2) the amount of trauma a pregnant uterus can stand without necessarily causing it to abort, and (3) the efficacy of modern drug therapy and early operation.

REFERENCES

Taussig. Abortions, Spontaneous and Induced.

Ross, J. N. M. and McLellan, P. D. Migration of foreign body in abdomen after attempted abortion. *Lancet*, 6: 13, 1942.

Kanter, A. H. Removal of glass drinking tube (used to produce abortion) from abdominal cavity. *Obio State M. J.*, 39: 1008, 1943.

Ferracani, R. S. Uterine perforation with grave intestinal lesions. Case with recovery. *Rev. méd.-quir. de pat. fem.*, 18: 64–74, 1941.

TORSION OF THE TESTICLE

CAPTAIN WILLIAM J. FOLEY
MEDICAL CORPS, ARMY OF THE UNITED STATES

THIS clinical entity, although not by any means common, is certainly not as rare a condition as it was considered a decade or so ago; for although V. J. O'Connor,[8] in 1919 reported a total of 124 cases on record, Abeshouse[1] in his complete review of the subject reported in 1936 a total of 350 cases including three cases of his own. This fully illustrates an increased awareness of the condition. However, failure of a large number of these cases to be diagnosed promptly and early, indicate that the diagnosis is not considered as soon as it should be. It is important that this diagnosis always be borne in mind because of the serious sequelae both psychological and physiological that may ensue, following an incorrect diagnosis or failure to institute proper treatment immediately after making the diagnosis. It is for the purpose of bringing to mind the possibility of this condition, that this case history and résume of the entity itself is reported.

The etiology has been generally recognized as being for the most part due to congenital anomalies of both the scrotum and its contents and anomalies in the descent of the testicle itself. In general, the anomalies are considered as being a hypermobility of the testicle and its presence in an enlarged scrotum.[3,4,7,9] A question of hypermobility is best explained on the basis of the anomalous descent of the testicle in which the testicle and the epididymis become completely surrounded by the tunica vaginalis, allowing the testis, epididymis and the distal spermatic cord to become an intravaginal body, without any lateral or posterior attachments, being attached to the base of the scrotum only by the remnants of the gubernaculum. The high attachment of the tunica vaginalis allows some of the lower fibers of the cremasteric muscle to be inserted inside the vaginal sac. Spasm of the muscle itself associated with a firmer contraction of one group of fibers may result in rotation of the spermatic cord, testicle and epididymis inside the vaginal sac, resulting in a torsion. Accepting this explanation as the cause of torsion, it is easy to comprehend why the condition may be relieved spontaneously in some cases while in others the torsion may cause continued spasm of the cremasteric and thus maintain the torsion. This theory seems the most likely one and was offered by Muchat[7] in 1931.

It must be realized that in addition to the congenital anomalies present, extrinsic factors may play an important rôle in inducing the condition. Of these factors, trauma and sudden muscular exertion appear to be predominant. The incidence of torsion in the fully descended testicle as against the undescended testicle remains an undecided point, some authors claiming as high as 50 per cent of torsion cases being in the undescended testicle.[11] It is in the fully descended testicle, however, that the best results can be obtained by early, correct diagnosis and treatment; yet it is in the fully descended testicle that diagnosis and proper treatment so often is delayed.

The age at which torsion of the testicle occurs is extremely variable for Hegner and Postma[5] report a case occurring at the age of four months and Wolf[13] reports a case at the age of sixty-eight years. V. J. O'Connor,[8] in 1919, stated the average in the 124 cases, however, occurred at the age of or just before puberty.[8]

The diagnosis in the fully descended testicle need not be too difficult just so long as the entity is borne in mind. In the case of the undescended testicle, its absence from the scrotum makes the differentiation between torsion of the testicle and a

Richter's hernia well nigh impossible in cases producing like symptoms. Cardinal symptoms of torsion in the fully descended testicle are a sudden onset of pain, the retraction of the testicle upward in the scrotum, swelling and tenderness. There may be nausea and vomiting and occasionally some chills with fever of a mild degree. Laboratory tests are negative at the onset unless there is concurrent disease.

The differential diagnosis presents its main problem in the consideration of an acute epididymitis. The lack of a history of infection, the sudden onset without temperature or increase in blood count, plus the physical findings will usually rule out an epididymitis. In addition, the testicle itself is tender and swollen in a case of torsion which is not the rule in a case of epididymitis at the onset. A useful diagnostic point between these two conditions is Prehn's sign,[6,10] namely, that in torsion cases the more the scrotum is elevated, the greater is the severity of the pain; which contrasts with the relief of pain with elevation of the scrotum in epididymitis. Orchitis and tumor of the testicle offer a similar differentiation. Physical examination of external rings will rule out a strangulated hernia when negative.

The condition encountered in an acute case of torsion which is not relieved immediately corresponds to that seen in a strangulated hernia. The vessels are deeply congested and prominent, small petechial hemorrhages are visible and the epididymis and testicle are swollen, and as the time interval increases, the color passes through the stages of cyanosis to that of complete gangrene. The testicle and epididymis then undergo an aseptic necrosis with softening of the parenchyma followed by a gradual replacement of the structures with fibrous tissue.

The treatment of acute torsion is decidedly surgical, although cases have been reported in which early manual detorsion has been successful.[12] The torsion is, of course, prone to recur and the process of detorsion is not always successful because it is impossible to determine accurately the number of degrees which the torsion has undergone and the direction in which it has occurred.

If detorsion is successful, the pain is immediately relieved; but again a partial detorsion may cause a marked reduction in pain and yet strangulation is present as is shown in the case presented here.

Surgical treatment, if instituted early, offers the only certain method of saving the testicle. The technic of surgical interference is variable, but must satisfy the two requirements of complete detorsion and attachment of the testicle to the scrotum in such a fashion as to preclude recurrence. If surgical treatment has been delayed and detorsion does not result in restoration of circulation and normal color, orchidectomy should be performed. Many men have advocated the prophylactic exploration of the opposite testicle and surgical correction of anomalies predisposing to torsion if present.[2,4,6,9]

The loss of one testicle results in no great physiological change so long as the opposite is normal and functioning; but in an individual who has previously lost the function of the other testicle, torsion is a major catastrophy. Psychologically, the loss of even one testicle is of major importance to the individual.

CASE REPORT

A soldier, age twenty-four, white, admitted to the hospital August 15, 1944, with the diagnosis of non-union of the left clavicle. The patient was injured in September, 1943, when he fell and fractured the left clavicle. Since that time he had moderate pain in the left shoulder region and tenderness over the junction of the middle and outer third of the left clavicle. Since the injury, he experienced difficulty in lifting and in doing heavy work. His past history was essentially normal except for attacks of tonsillitis and a fracture of the right clavicle in 1932. Physical examination revealed only moderate, bilateral enlargement of the tonsils and a small enlargement of the right testicle which was considered a small hydrocele. There was a deformity over the

middle third of the left clavicle with motion at the fracture site. The *x*-rays showed a non-union, middle third of left clavicle with a pseudo-arthrosis. The patient had an inlay bone graft of the left clavicle on August 23, 1944.

Progress was uneventful until October 16, 1944. At 3.00 A.M. October 16, 1944, the patient awakened from his sleep and started to get out of bed to go to the lavatory when he experienced a sharp pain in the right scrotum, became nauseated, and started vomiting. He was examined at 3.15 A.M. at which time the physical findings were a localized tenderness of the right testicle which was slightly enlarged. Pressure on the testicle made the patient even more nauseated and brought on a spell of vomiting. There was no redness or inflammation present. A diagnosis of torsion of the testicle was made. Upon rotating the right testicle laterally (counter-clockwise) the pain increased, but on rotating it medially (clockwise) the pain lessened. The right testicle was rotated 180 degrees medially and the pain and nausea disappeared. The patient felt comfortable. At 4.30 A.M., the patient had a recurrence of the original pain with nausea and vomiting. Examination at this time showed a drawing up of the right testicle with markedly increased tenderness of the testicle over the previous examination, and a beginning tenderness of the cord just below the external ring. The testicle did not appear any larger than on the previous examination. Elevation of the scrotum did not relieve the patient's pain. An attempt was made at detorsion but there was no decrease in pain on rotation of the testicle through 180 degrees either counter-clockwise or clockwise. Because of the marked nausea and vomiting, a flat plate of the abdomen was taken to rule out an atypical ureteral stone. This was negative. Following the *x*-rays, the patient's nausea and vomiting decreased and it was believed that the patient should be observed. The testicle was still very tender. His general condition improved in the next twenty-four hours but there was still an occasional spell of nausea and vomiting.

Examination on October 17, showed similar findings with an increased enlargement of the right testicle and increased tenderness of the cord below the external ring. He was operated upon October 17th, under local procaine anesthesia. The incision was made in the right scrotal sac. Upon incising the tunica vaginalis, the testicle was found to be rotated 360 degrees counter-clockwise and was found to be an intravaginal body. The testicle was markedly discolored from dusky red to definitely blue and black areas. The torsion was reduced and the testicle observed over a period of twenty minutes when it showed a marked increase in circulation with a beginning return to normal color. Due to the return of circulation, it was thought that orchidectomy was not indicated. Andrew's bottle operation for hydrocele was performed. In addition, a mattress suture of silk was introduced through the lower pole of the testicle which was anchored to the dependent portion of the right scrotum. The scrotum was then closed leaving a small penrose drain in the dependent portion of the wound.

Convalescence was uneventful with the exception of a localized edema of the prepuce which lasted until October 24th. The drain was removed on October 20th. The patient was up and around on November 2, 1944, with the wound completely healed. The testicle had not quite returned to normal size and no pain was experienced on compression. He was seen on December 19th and the testicle was found to be about the same size as the one on the left. There was tenderness on compression of the epididymis on the right but none on compression of the right testicle which was quite firm in consistency. Aspiration of the right testicle was done under local anesthesia and the laboratory reported in the stained smears "evidence of spermatogenesis, several cells were identified with rudimentary tails which were thought to be spermatids undergoing transformation to spermatozoa."

SUMMARY

1. Torsion of the testicle is not a rare condition and the diagnosis should always be considered in cases of testicular pain.

2. Successful treatment of torsion is immediate surgery with detorsion and fixation of the testicle to prevent recurrence.

3. Orchidectomy may be avoided by early diagnosis and the institution of immediate surgery avoiding all procrastination.

4. In cases of doubt as to the absolute certainty of the diagnosis, surgical exploration under local anesthesia of the involved testicle is advised.

5. A case of torsion of the right testicle in which manual detorsion was unsuccessful and in which surgical detorsion accompanied by fixation of the testicle was successful is presented for record.

REFERENCES

1. Abeshouse, B. S. Torsion of the spermatic cord. *Urol. & Cut. Rev.*, 40: 699, 1936.
2. Bailey, Hamilton: Torsion of the Fully Descended Testis, Emergency Surgery. P. 474. Baltimore, 1944. Williams & Wilkins.
3. Campbell, Meredith F. Torsion of the spermatic cord. *Surg., Gynec. & Obst.*, 44: 311, 316, 1927.
4. Colby, Flether H. Torsion of the spermatic cord with gangrene. *New England J. Med.*, 203: 16, 1930.
5. Hegner, C. F. and Postma, G. S., Torsion of the spermatic cord. *Am. J. Surg.*, 47: 121–123, 1940.
6. Kinney, Willard H. Torsion of the spermatic cord. *J. Urol.* 34: 470, 1935.
7. Muschat, Maurice. The pathological anatomy of testicular torsion. *Surg., Gynec. & Obst.*, 54: 758, 1932.
8. O'Connor, V. J. Torsion of the spermatic cord. *Surg., Gynec. & Obst.*, 29: 580, 1919.
9. Ottenheimer, E. J. and Bidgood, C. Y. Testicular fixation in torsion of the spermatic cord. *J. A.-M. A.*, 101: 116–119, 1933.
10. Prehn, Douglas. A new sign in the differential diagnosis between torsion of the spermatic cord and epididymitis. *J. Urol.*, 32: 191, 1934.
11. Roche, A. E. *Clin. J.*, 57: 577, 1928.
12. Smith, R. E. Torsion of the testis. *Clin. J.*, 63: 250, 1934.
13. Wolf, Monroe. Torsion of the testicle. *Am. J. Surg.*, 27: 483, 1942.

It is of the highest importance that prostatectomy should neither be attempted in the presence of gross infection nor until it has been proved that renal function is adequate. Preliminary ligation and division of the vasa deferentia has banished the troublesome complication of post-operative epididymo-orchitis.

From "A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (H. K. Lewis & Co. Ltd.).

GRANULOCYTOPENIA COMPLICATING SULFADIAZINE THERAPY IN A SEVERE INTESTINAL INJURY

REPORT OF A CASE IN WHICH PENICILLIN WAS EMPLOYED TO SUPPLEMENT OTHER THERAPEUTIC MEASURES

COLONEL JAMES E. FISH AND MAJOR HAROLD A. CONRAD
MEDICAL CORPS, ARMY OF THE UNITED STATES

THIS case is reported because of the following interesting features: (1) Multiple perforations of both the large and small intestine from a 30-calibre machinegun bullet were successfully handled in accordance with generally accepted surgical principles. (2) The complicating peritonitis, secondary to widespread soiling of the peritoneum, was successfully combated by means of combined sulfonamide and penicillin therapy without a residual abscess formation or complicating wound infection. (3) An unusual urinary tract complication, due to coincidental injury of the parasympathetic nerves in the sacral plexus, was encountered. (4) A severe granulocytopenia developed as a complication of the sulfonamide therapy. (5) Penicillin was employed as an adjunct to other therapeutic measures in the management of the complicating agranulocytosis.

CASE REPORT

A twenty-five year old soldier was admitted to this hospital at 9 P.M. on December 29, 1943, because of intra-abdominal injuries sustained two hours previously from accidental shooting with a 30-calibre machinegun bullet fired at point blank range.

Physical examination revealed a patient in severe shock. The pulse rate was 136 and quite thready. The blood pressure at first could not be registered, but after a short time was recorded at 90 systolic and 60 diastolic. The wound of entrance was a ragged hole about 1.0 cm. in diameter in the right lower quadrant of the abdomen from which came a moderate bloody ooze. The wound of exit was in the left sacral region, where there was another ragged hole approximately 1.5 cm. in diameter.

After the administration of two units (500 cc.) of plasma, his condition had improved to the point where it was believed that surgery could be instituted. At that time his pulse rate was 104 and the blood pressure was 100 systolic and 70 diastolic; 500 cc. of citrated whole blood was administered during the operative procedure as well as one additional unit (250 cc.) of plasma.

Under ether anesthesia, the abdominal cavity was entered through a right lower paramedian incision. Hemorrhage had been profuse, due to bleeding from several large vessels in the mesentery of the terminal ileum and sigmoid. There was also a moderately severe ooze from the retroperitoneal wound deep in the hollow of the sacrum. Examination showed one perforation in the cecum, three in the terminal ileum, two in the sigmoid colon, and two in the rectum just above the peritoneal reflection. (Fig. 1.)

There was gross fecal contamination, and a considerable quantity of fecal material was removed from the peritoneal cavity during the course of the operation. The perforations in the rectum, cecum, and ileum were closed using atraumatic No. 0 chromic catgut. The damaged mesentery of the ileum was also repaired. The involved sigmoid loop was exteriorized after approximation of the proximal and distal limbs to facilitate the later application of a spur crushing clamp. The colostomy loop was brought out through the main incision. Two cigarette drains were inserted into the retroperitoneal wound, and two additional cigarette drains placed in the bottom of the pelvis. These were brought out through the lower angle of the operative incision. Prior to closure, 12 Gm. of sulfanilamide powder were placed in the peritoneal cavity. The wounds of entrance and exit were then débrided and packed loosely with vaseline gauze. At the conclusion of the operation, which took one and three-quarter hours, the pulse rate was 128 and the blood pressure was 108 systolic and 58 diastolic.

After removal to the ward, he was placed in an oxygen tent. A Levine tube was passed into the stomach and connected to a constant suction apparatus. An additional 500 cc. of citrated whole blood and two units (500 cc.) of plasma were given during the day following operation. A blood sulfanilamide level taken twelve hours after operation showed only a trace (less than 1.0 mg. per cent). Accordingly he was given intravenously 5 Gm. of sodium sulfadiazine in distilled water. His pulse rate varied from 124 to 160 during the day. Although his temperature was only 101.0°F. by rectum, he appeared extremely toxic and was irrational most of the time. Penicillin, at that time available only in very limited quantities, was started eighteen hours after operation, 12,500 units being given intramuscularly every two hours.

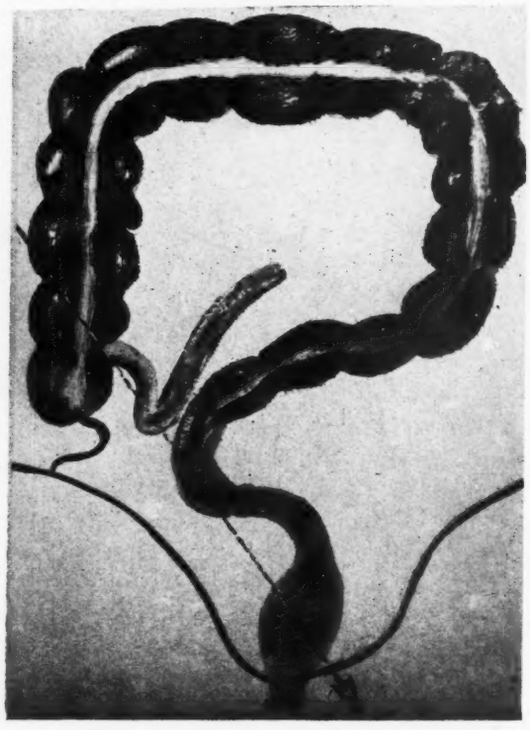


FIG. 1. Diagram illustrating the course of the missile through the peritoneal cavity and the organs involved.

The condition of the patient improved considerably during the second postoperative day. He appeared much less toxic and there was a slowing of the pulse rate. A blood sulfanilamide level taken thirty-six hours after operation was reported as 20.6 mg. per cent. The plasma protein level was 6.75 per cent. The penicillin dosage was reduced to 8,750 units every two hours. An adequate fluid intake was provided by the administration of glucose and saline, and glucose and distilled water intravenously. Thiamin chloride and vitamin C (cenolate), 1.0 cc. of each, were given intramuscularly daily. There was no abdominal distention. The continuous suction functioned efficiently. About 1,000 cc. of drainage were returned in a twenty-four hour period.

By the third postoperative day all signs indicated continued improvement. He was irrational only at rare intervals. Peristalsis could be heard on abdominal auscultation. He was started on two ounces of water an hour. The constant suction tube was left in place but was clamped off for several hours at a time with no ill effects. He was again given 500 cc. of whole citrated blood. The blood sulfadiazine level was 7.8 mg. per cent and he was given intravenously another 5 Gm. of sodium sulfadiazine. The pulse showed further improvement. He remained out of the oxygen tent for several hours. He continued to gain during the next several days. The colostomy began functioning ninety-six hours after operation. He was placed on a semi-soft diet on the tenth postoperative day.

The penicillin dosage was gradually reduced and discontinued entirely after the fourth postoperative day. He had received a total of 300,000 units during that time. No sulfonamide was administered on the third postoperative day, but with this exception he received 5 Gm. of sodium sulfadiazine intravenously from the second to the twelfth days inclusive. From the thirteenth to the eighteenth days inclusive he received 1 Gm. of sulfadiazine orally four times daily. The blood sulfonamide level following the peak of 20.6 varied from 7.8 on the fourth to 1.9 on the ninth, and 4.3 mg. per cent on the eighteenth postoperative day. (Fig. 2.)

The leucocyte count was followed at two-day intervals. Following a low of 6,000 on the fifth postoperative day, there was a rise to 14,000 on the twelfth postoperative day. By the nineteenth postoperative day, it had fallen to 4,000 with 68 per cent polymorphonuclear cells. No sulfonamide was administered after the eighteenth postoperative day. Two days later his leucocyte count had fallen to 1,200 with 99 per cent lymphocytes. The erythrocyte count was 2,800,000 and the hemoglobin 85 per cent.

He again appeared critically ill. A diagnosis of agranulocytosis secondary to the administra-

tion of sulfadiazine was made. Repeated transfusions of 250 cc. citrated whole blood were instituted. Liver extract was also given in the leucocyte count with an increasing percentage of neutrophiles. Fortunately, in this case the bone marrow recovery was swift and

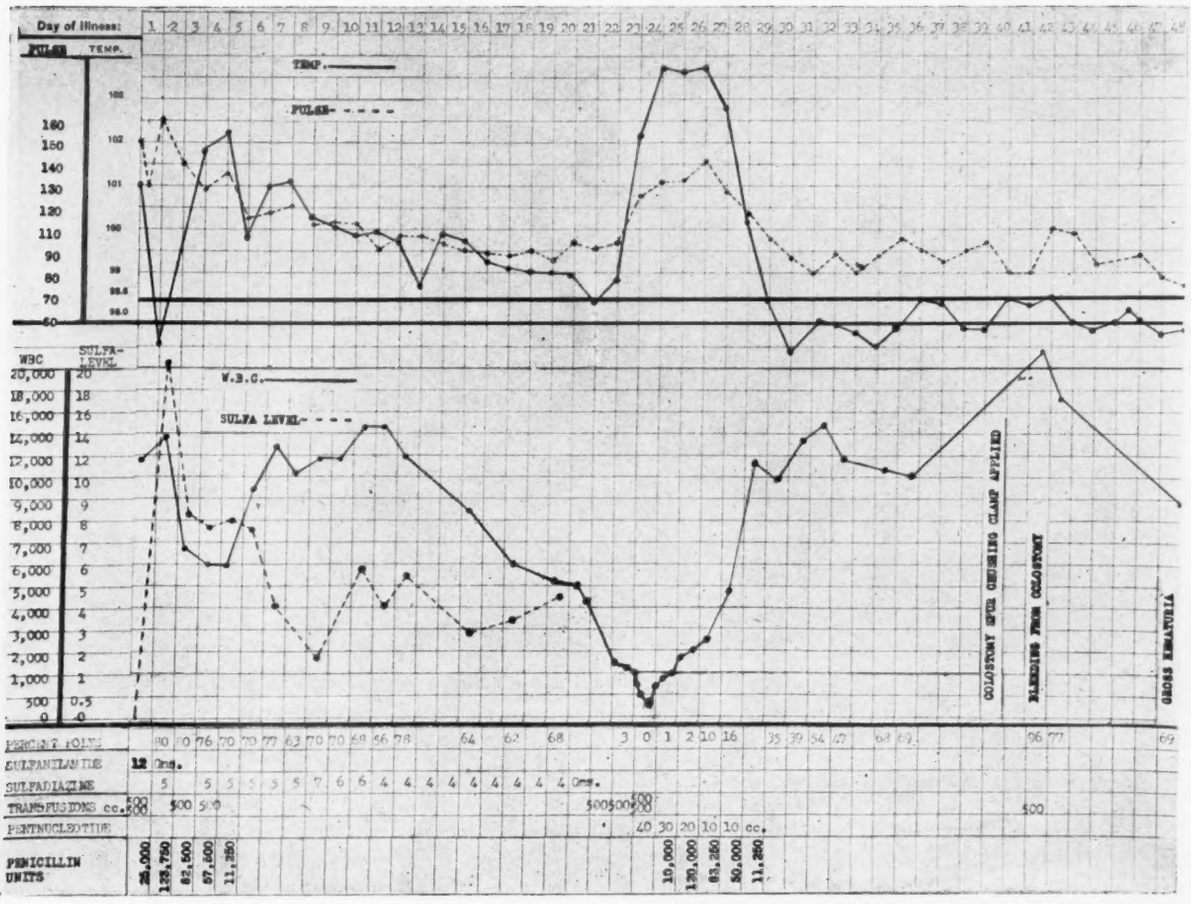


FIG. 2. A chart of the temperature, pulse, leucocyte counts and blood sulfonamide levels following operation.

daily doses of 1.0 cc. intramuscularly. Pentnucleotide was started on the day following recognition of his agranulocytosis, with the intramuscular injection of 40 cc. In addition to the above measures, penicillin was resumed on the third day of his agranulocytosis as a prophylactic measure. This was to bolster the body defenses against anticipated pyogenic complications pending the restoration of a normal granulocyte reaction. The leucocyte count two days following onset was 600 with a differential of 2 per cent neutrophiles and 95 per cent lymphocytes. A day later the leucocyte count was 400 with 100 per cent lymphocytes. On the following day, however, the first encouraging response in the leucocyte count was noted when it showed 850 cells with a differential count of 1 neutrophile, 90 lymphocytes, 7 monocytes, and 2 basophiles. From this time on there was a gradual but steady increase in it was possible to discontinue the penicillin on the seventh day following recognition of the agranulocytosis. Pentnucleotide was also discontinued after a total of 110 cc. had been administered. At that time the leucocyte count was 10,500 with 16 per cent neutrophiles and 30 per cent lymphocytes, the balance being immature forms. At no time during this serious complication was there any indication of acute pharyngitis, mucosal ulcerations, or a latent pyogenic infection.

A colostomy spur crushing clamp was applied on the fortieth postoperative day. Two days later there was some bleeding from the bowel edge which was controlled by the application of Monsell's solution. A leucocyte count taken at this time is of interest in that it was found to be 24,000 with 96 per cent neutrophiles. The spur was completely cut through in one week following application of the clamp. At this time

he began to complain of considerable dysuria and his urine, heretofore normal, became grossly bloody. The question immediately arose as to the possibility of a beginning vesicorectal fistula. A fecal odor to the urine was not noted and the patient denied the passage of any gas through the urethra. The urine continued to be grossly bloody, but cultures were sterile. Bleeding and clotting times were normal.

The patient volunteered the information that when he urinated his "bladder didn't seem to contract like it did before his injury but just folded up."

Urological consultation was secured and cystoscopy showed a loss of bladder tone with marked redundancy of the bladder mucosa. No evidence of a vesicorectal fistula was seen. A cystogram was taken and revealed a dilated bladder with a reflux of the opaque media up each ureter and into the kidney pelvis. (Fig. 3.)

The ureters were somewhat dilated. In the opinion of the urologist, this condition represented a neurogenic bladder, resulting from injury to the sacral plexus. It was believed that the bleeding was due to congestion of the redundant bladder mucosa. The patient was encouraged to void frequently. The urine remained uninfected and the hematuria gradually subsided.

Fig. 3. Cystogram showing reflux of the opaque media up each ureter and into the kidney pelvis.

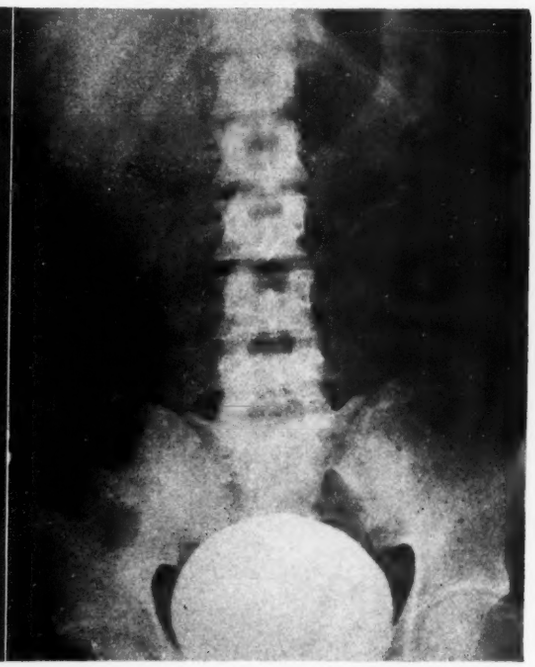


Fig. 4. Cystogram taken two months later showing normal bladder and no demonstrable reflux up either ureter.

Closure of the colostomy was done under sodium pentothal anesthesia on the eighty-second day following the original injury. Sulfanilamide was not used in the wound, which healed solidly and rapidly without incident. The convalescence from this point on was uneventful. A cystogram was repeated by the urological service two months after the original attack of hematuria, and a series of cystometric readings were taken. The residual urine was found to be less than 20 cc. and the study indicated that the bladder was regaining normal tone. There was no reflux of the opaque media up either ureter. (Fig. 4.)

At the time of his discharge from the hospital, he was fully ambulant. He had gained steadily in weight and was feeling and looking very well. He was returned to the mainland for sick leave, following which it appeared that he would be able to return to full duty.

COMMENT

The continuance of the sulfonamide therapy in this instance may appear to have been unnecessarily prolonged. It should be pointed out that the fecal contamination was extremely widespread, and

the subsequent peritonitis very severe. The continuation was dictated, in our opinion, in light of past experiences in which a number of cases of apparently "recovered" peritonitis developed residual abscesses following the early withdrawal of the drug.

The absence of pyogenic complications during and following the agranulocytosis may have been attributable to the relatively brief duration of this condition. On the other hand, the agranulocytosis, although of brief duration, was of great severity and the absence of pyogenic sequalae is noteworthy.

There are two schools of thought in regard to therapy in agranulocytosis due to drug sensitivity. The first is expressed by Dameshek:[1] "If the bone marrow leucocytes are not irretrievably damaged, the patient will recover; otherwise the effects of therapy in a given case are very dubious." The second is expressed by Jackson[2,3] who has stated: "In seventy-two personally collected cases of extreme agranulocytosis (without anemia of moment) due to sulfonamide compounds or other drugs, recovery occurred in but 30 per cent of these in which withdrawal of the drug was the only measure taken. In twenty-six similar cases in which the drug was withdrawn and adequate amounts of pentnucleotide (40 cc. daily) were given, recovery occurred in 66 per cent. The series is small, but the results are suggestive. In any event, daily leucocyte and differential counts should be done on all cases suspected of having agranulocytosis, and energetic measures should be taken immediately after the diagnosis is established."

We chose to treat this case "energetically." In addition to stopping the drug, transfusions, liver extract, and pentnucleotide were employed. For the purpose of suppressing pyogenic infection pending the resumption of normal bone marrow activity, we believed that penicillin on theoretical grounds should be included in the energetic measures employed in the management of this case. There is some evidence for the belief that it was of definite benefit. The inclusion of this drug among the "energetic" measures to be employed in the treatment of agranulocytosis is recommended pending further evaluation of the many factors involved in this condition.

REFERENCES

1. Dameshek, William. Report on medical progress; hematology. *New England J. Med.*, 222: 1000–1010, 1940.
2. Jackson, H. Jr. Leukemias. *New England J. Med.*, 222: 22–28, 1940.
3. Jackson, H. Jr. Report on medical progress; leukemia, agranulocytosis. *New England J. Med.*, 225: 978–982, 1941.

SUBMUCOUS LIPOMAS OF COLON WITH SPECIAL REFERENCE TO ACUTE AND CHRONIC INTUSSUSCEPTION

JOSEPH A. LAZARUS, M.D. AND MORRIS S. MARKS, M.D.
NEW YORK, NEW YORK

OUR interest in this subject was aroused by a patient who recently presented herself for treatment. In previous statistical reports such as that of Stetten, in 1909, the compilations dealt with submucous lipomas involving all parts of the gastrointestinal tract. Pemberton and McCormack presented a comprehensive report on this condition in the Journal of Surgery in 1937. In 1941, Gault and Kaplan presented a paper dealing with submucous lipomas confined to the colon and associated with intussusception, based on a compilation of 127 previously reported patients, and one report by the authors.

Lipomas involving the bowel occur as subserous and submucous tumors, the latter being the more frequent; and it is with this latter group that we shall concern ourselves here. This condition is considered relatively rare, as is attested to by Staemmler who, in 17,000 consecutive autopsies, found only nine lipomas involving the gastrointestinal tract, an incidence of 0.05 per cent; and by Comfort who found only twenty-four tumors out of 3,924 consecutive autopsies at the Mayo Clinic (0.061 per cent). However, in view of the fact that in a large number of instances the tumor may be entirely asymptomatic (11.6 per cent), we agree with Hellstrom that this condition is far more prevalent than the literature would lead us to believe.

PATHOLOGY. Submucous lipomas belong in the category of true lipomas, and as far as can be ascertained, are never congenital in origin. The tumor is, in the vast majority of instances, polypoid, well circumscribed and encapsulated, either sessile or pedunculated, and usually occurs singly, although cases of multiple lipomas have been reported. The tumor shows no tendency to assume malignant propensities, although it is prone to undergo a variety of intrinsic alterations such as hemorrhage, cystic degeneration, inflammatory changes or necrosis. The mucous membrane covering the tumor is usually atrophied and scarred, although it may be hypertrophic. Instances have been reported in which the mucosa had completely sloughed off over the growth. The tumor originates from the fat cells in the connective tissue stroma of the intestinal submucosa.

Submucous lipomas are slightly less frequent than adenomatous polyps, but in comparison to carcinoma they are extremely rare.

Symptomatology. In many instances the condition is asymptomatic, particularly when tumors are small (11.6 per cent). Large tumors, however, are always associated with symptoms. Depending upon the character and size of the growth, and the condition of the bowel wall harboring it, the presenting symptoms may be chronic or acute.

In chronic cases the patient may complain of vague abdominal pains, intermittent or continuous. At times the pain may be colicky or diffuse, and frequently localized to the site of the tumor, where it may be mistaken for other intra-abdominal disorders such as cholecystitis or appendicitis. Constipation is an outstanding symptom, and is often associated with diarrhea. When associated with partial invagination of the involved portion, and when the lumen of the bowel is materially reduced, chronic obstipation may occur. Stools frequently contain mucus, blood or pus,

or all three, depending upon the degree of degeneration of the tumor. Large tumors may occasionally be felt through the abdominal wall, particularly in thin patients. When situated in the rectum they can almost always be detected on rectal digital examination, regardless of size.

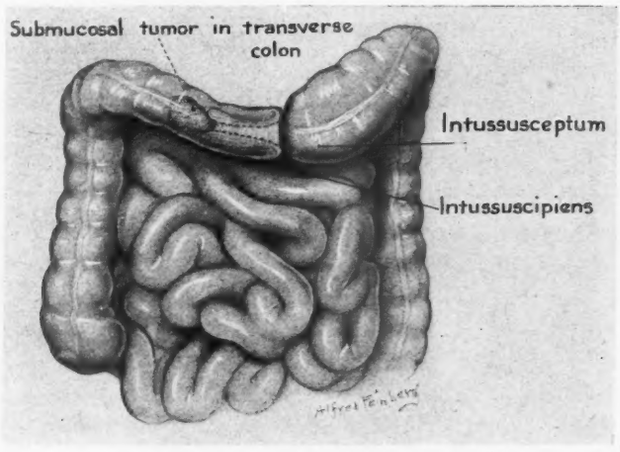


Fig. 1. Schematic drawing showing relationship of submucosal lipoma to intussusception of transverse colon.

Acute syndromes result from acute intestinal obstruction, due most frequently to intussusception and occasionally to complete obstruction from the tumor itself without intussusception. In Stetten's series, 43 per cent of the patients, not including those with rectal involvement, were associated with intussusception. In our series, 45 per cent were associated with intussusception. The tumor has always been found situated at the tip of the intussusception. Stetten found intussusception present fourteen times when the tumor involved the small intestine, and fifteen times when the colon was involved. In only two patients was the obstruction caused solely by the tumor (Bland-Sutton, Russell).

When the growth is situated in the rectum the patient usually complains of tenesmus and constipation. Blood and mucus are frequently found in the stool. Invariably a polypoid tumor can be felt on rectal examination. Stetten found seven such tumors in his series.

Prognosis. In our series, fourteen patients (11 per cent) expelled the tumor spontaneously and went on to eventual recovery. The remaining patients developed acute symptoms and required surgical intervention. In the latter group, the mortality rate was 11 per cent.

Treatment. In chronic cases in which the identity of the tumor can be established presurgically, the best treatment is colostomy with extirpation of the tumor. However, where the identity of the growth is uncertain, it is best to perform resection of the involved portion of the colon.

When acute, surgery is urgently indicated. Tumors unassociated with intussusception are best treated by colostomy with removal of the growths when their precise identity is known before operation. When intussusception is present, it should be reduced whenever possible, and the tumor removed after opening the bowel. In instances of irreducible intussusceptions, several procedures are available. The bowel may be opened and the intussusception removed at its base; or the entire involved portion may be resected and the continuity of the bowel restored by end-to-end or side-to-side anastomosis. An even safer operation is the exteriorization procedure of Mikulicz. However, when a patient's condition is such as to preclude radical surgery, simple enterostomy should be carried out proximal to the obstruction, and radical resection of the involved portion of bowel performed

at a later date when his condition has improved sufficiently to enable him to safely withstand such an ordeal.

FIG. 2. Photograph showing surface of tumor.

Rectal tumors are best treated by extirpation after manually reducing the invagination when present.

CASE REPORT

Mrs. R. K., aged sixty-five years, was seen in consultation on February 17, 1942. Her complaints were severe constipation and abdominal pain. She stated that she had had no bowel movement during the past four days, although she had noted several bouts of diarrhea during the previous month, occasionally associated with nausea and vomiting.

Family and past histories were irrelevant. There was no loss of weight.

Physical examination revealed a well developed, elderly female who appeared ill. The abdomen was soft but moderately tender, with positive rebound elicited over the right lower quadrant. Save for these findings, the physical examination was essentially negative. Blood count: red blood count, 4,240,000; white blood count, 12,000; polymorphonuclears 80 per cent; lymphocytes 19 per cent; eosinophiles 1 per cent.

A tentative diagnosis was made of acute appendicitis and operation advised.

Operation was performed on February 27,

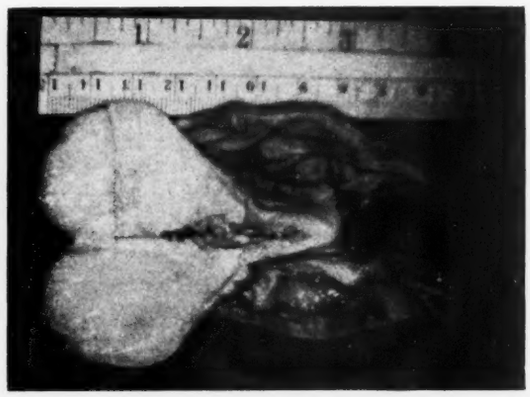


FIG. 3. Photograph showing tumor bisected.

1942, by one of us (J. A. L.). Under spinal anesthesia the abdomen was opened through a four inch right rectus muscle splitting incision. The appendix was found uninvolved, but the terminal ilium, cecum, and ascending and proximal portions of the transverse colon were distended. The examining hand passed along the transverse colon disclosed a large mass involving the distal portion of the transverse colon and splenic flexure. The right rectus incision through which this exploration was carried out was closed in layers, and a second incision made through the left upper rectus muscle. This was extended outward along the left costal arch. The great omentum was drawn out of the abdomen, bringing the terminal portion of the transverse colon into view. It was immediately evident that we were dealing with an intussusception of this portion of the bowel. After reducing the intussusception by traction, a tumor about the size of a large peach was palpated within the bowel, which had apparently formed the apex of the intussuscepted portion of bowel. (Fig. 1.) The tumor-bearing portion of colon was easily drawn out of the abdomen. Both limbs of the adjacent colon were approximated for a distance of about three inches with two layers of fine Pagenstecher sutures, and the peritoneum was securely sewed around this loop, but no sutures were passed between the peritoneum and the intestinall wall (first-stage Mikulicz). The rest of the abdominal wall was closed in layers. A transfusion of 500 cc. of citrated blood was given the next morning.

Five days later the extruded portion of the transverse colon containing the tumor was resected with a carbolized knife.

On April 16, 1942, a typical Mikulicz closure of the colostomy was performed, and the patient made an uneventful recovery.

Barium enema roentgenograms carried out two months later showed no defect in the transverse colon at the site of the anastomosis.

Pathological Report. "Macroscopic: Specimen consists of a resected portion of colon measuring 11 × 7 cm. The serosal surface is dull, hemorrhagic and discolored. Projecting from the lumen of the distal edge there is a plum-sized polypoid mass measuring 4.5 × 5 × 3.5 cm. This projects into the lumen and beyond the distal edge. Its surface is hemorrhagic and discolored in some areas and pale and slightly yellowish in others. The surface is continuous with the mucosal lining of the lumen. The mucosal folds of the internal mucosal lining above the site of the polypoid mass show exaggerated thickenings which become entirely smooth over the mass, (Fig. 2.) On section the mass itself seems to be well localized and encapsulated. It consists of typical lobulated adult fatty tissue showing no unusual features. It is situated within the submucosa. Six cm. of the gut are present above the mass and 0.4 cm. of mucosa are present beyond the mass in some areas. In other areas the resection has been carried out at the point of projection of the mass above the distal mucosa. The wall of the gut proximal to the mass is hypertrophic. The contents of the mass do not penetrate its capsule. (Fig. 3.)

"Microscopic: The polypoid mass is covered by a layer of mucosa containing regular mucosal glands lined by regular columnar and cuboidal cells. There is slight fibrosis and scattered round cell infiltration of the mucosal stroma. The subjacent submucosa consists of dense collagenous fibrous tissue which forms the capsule of the mass noted in the gross. The latter consists of typical adult adipose tissue showing no unusual features. The nuclei of the fat cells are small and flat. The cytoplasm is clear. There is no penetration of the capsule by the enclosed fatty tissue. Sections through the adjacent gut wall show edema, interstitial hemorrhage and leukocytic and round cell infiltration, especially in the subserosal layer. In some areas within the submucosa of the gut wall in some distance from the tumor mass there are numerous scattered large fat cells of the adult type. In places these fat cells are present in aggregations which have no special capsule. There is fatty infiltration by regular adult fat cells within the subserosal layer.

"Diagnosis: (1) polypoid submucosal lipoma of colon; (2) fatty deposition of adjacent submucosa; (3) acute inflammation of adjacent gut."

CONCLUSIONS

1. Lipomas of the colon occur as subserous and submucous tumors.

2. Submucous lipomas are rare, are considered true lipomas, are never congenital in origin, and never undergo malignant changes.

3. When small, these tumors are frequently asymptomatic. Constipation and colicky abdominal pain are frequent symptoms in the larger tumors. Obstipation and signs of acute intestinal obstruction make up the syndrome in patients with acute intussusception.

4. Intussusception was found in 45 per cent of the reported patients, and the tumor has always been found at the tip of the intussusception.

5. In 11 per cent of the reported cases the tumor was spontaneously expelled.

6. Colostomy and extirpation of the tumor is the procedure of choice in which the identity of the tumor can be established prior to operation. Where identity is uncertain, the best treatment is segmental resection of the affected portion of bowel.

REFERENCES

BLAND-SUTTON, J. On a fatty tumour of the ascending colon; enterectomy; recovery. *Lancet*, 1: 1437, 1900: Fibroids, lipomas, dermoids and polypi of the stomach and intestine. *Lancet*, 2: 5–9, 1920.

COMFORT, M. W. Submucous lipoma of the intestinal tract as a cause of intestinal obstruction. *Ann. Surg.*, 101: 734, 1935.

GAULT, J. T. and KAPLAN, P. Submucous lipoma of the colon. *Am. J. Surg.*, 53: 145–151, 1941.

HELLSTRÖM, N. Kasuistische Beiträge zur Kenntnis des Intestinallipoma. *Deutsche. Ztschr. f. Chir.*, 84: 488–511, 1906.

PEMBERTON, J. DEJ. and MCCORMACK, C. J. Submucous lipomas of the colon and rectum. *Am. J. Surg.*, 37: 205, 1937.

RUSSELL, A. E. Intestinal obstruction; polypoid growth in sigmoid flexure; operation; recovery. *St. Thomas Hosp. Rep.*, 28: 60–61, 1899.

STAEMMLER, M. Das Lipom., in: Reichel und Staemmler, Die Neubildungen des Darmes. Part 1. Enke Stuttgart, 273, 1924.

STETTEN, D. The submucous lipoma of the gastrointestinal tract. A report of two successfully operated cases and an analysis of the literature. *Surg., Gynec. & Obst.*, 9: 156, 1909.

FISTULA OF SUBMAXILLARY GLAND FOLLOWING EXCISION OF THYROGLOSSAL CYST

LIEUT. COL. H. B. JENKINS
MEDICAL CORPS, ARMY OF THE UNITED STATES

THE complete removal of thyroglossal cysts, sinuses or fistulas remains a surgical problem in spite of the pronounced improvement in the treatment of these conditions following the general adoption of the operative procedure as described by Sistrunk[16] in 1928. The percentage of cures in any series will depend upon the degree of thoroughness of the operator in removing all epithelial remains of the thyroglossal tract. That a meticulous dissection is the chief factor in obtaining a cure is noted in the report of Pemberton and Stalker[14] on 261 operative cases from 1920 to 1938 at the Mayo Clinic with only four recurrences, (1.5 per cent) although 166 or 63.6 per cent had had, elsewhere, from one to ten unsuccessful operations. Other favorable reports include those of Clute and Cattell[4] who had no recurrences among fifty-eight cases and Gross and Connerley[8] with no recurrences among ninety-one cases.

In the diagnosis of a thyroglossal cyst the factor emphasized by most authors has been the midline, or near the midline location of the tumor usually between the thyroid cartilage and the hyoid bone. That the tumor of a thyroglossal cyst may be found away from the midline is noted in a case reported by Fraser[6] who found a cyst left of the midline in the hyoid bone and who believed that a portion of the thyroglossal tract branched at the hyoid bone into several buds which deviated from the midline. Parsons,[13] in lipiodol studies of a thyroglossal fistula with submental opening, noted a tract running to the hyoid bone and thence to the foramen cecum but with several branching processes just above the hyoid bone. Russell[15] has reported a case in which a thyroglossal cyst was located beneath the right submaxillary gland and another case in which a midline cyst proved to be a retention cyst of the right submaxillary gland. No other reports of the occurrence of retention cysts of the submaxillary gland in the midline have been noted in the reviews of cysts, sinuses or fistulas of the neck.[1–18] McClintock[10] states that it is almost impossible to distinguish a dermoid or a sebaceous cyst in appropriate places from a cyst of the thyroglossal tract and cites a case in which a colloid adenoma of the thyroid and another in which a sebaceous cyst were diagnosed as thyroglossal cysts. Lipomas, ranulas, hemangiomas and discrete tuberculous glands in the submental area have been mentioned as conditions to be considered in the differential diagnosis. Clute and Cattell[4] are of the opinion that there are few lesions to confuse with thyroglossal cysts and that the diagnosis depends upon movement with deglutition, intimacy with the hyoid bone and midline location.

In reviewing the literature on thyroglossal cysts, sinuses or fistulas no case has been encountered in which a fistula of the submaxillary gland followed the excision of a thyroglossal cyst or sinus. In the following case report an operation was performed to remove a thyroglossal cyst on September 3, 1941, and was followed by another operation on September 28, 1942, to excise a thyroglossal sinus and by still another operation on July 7, 1943, for excision of a thyroglossal sinus. With the latter operation the excision of the left submaxillary gland resulted in the cure of a condition that had been diagnosed repeatedly as a thyroglossal sinus.

CASE REPORT

A white male, age twenty-seven, was admitted to the Station Hospital, on June 30, 1943, for treatment of a persistent draining sinus of the neck. In July, 1941, he had noted a swelling beneath the chin and in the midline of the neck and was operated upon September 3, 1941, in a hospital in Massachusetts and discharged as cured nine days later. An abstract of his clinical record which was obtained from that hospital showed a preoperative diagnosis of thyroglossal cyst and following preoperative injection of methylene blue excision of the cyst by the Sistrunk method. The preoperative diagnosis was confirmed at operation and by subsequent tissue examination. Three weeks after discharge from the hospital the patient developed a draining sinus in the midline of the neck through the old surgical scar.

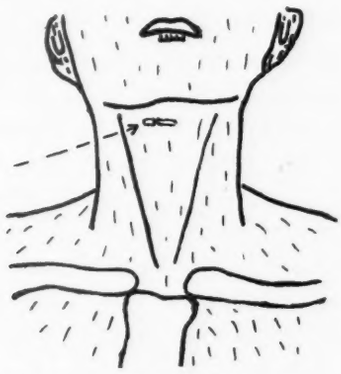


Fig. 1. Fistula from left submaxillary gland opening below hyoid bone and to right of midline.

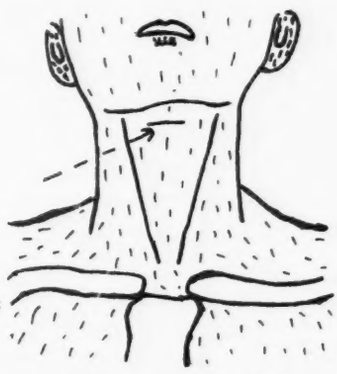


Fig. 2. Operative scar below hyoid bone following excision of submaxillary gland and fistula.

About one year later, on September 28, 1942, he was operated upon in a hospital in Florida where a preoperative diagnosis of thyroglossal sinus was made and another Sistrunk operation was done after injection of methylene blue into the sinus tract. The preoperative diagnosis was confirmed at operation and the patient was discharged as cured on October 3, 1942. Again, about three weeks after discharge from the hospital, the patient developed a draining sinus in the operative scar just to the right of the midline from which there has been daily spontaneous drainage. The patient had had measles, mumps, whooping cough and chickenpox in early childhood and no other illnesses, and no operations other than those mentioned above and no injuries. His father, mother, two brothers and three sisters were living and well with no members of immediate family dead and no record of any familial diseases.

The patient was a well developed and nourished white male, age twenty-seven, 70 inches (178 cm.) high and weighing 170 pounds (77 Kg.). On admission his temperature was 97.8°F., pulse 74, respiration 18 and blood pressure 126/70. There was a draining sinus on the neck midway between the hyoid bone and the thyroid cartilage, about 1 cm. to the right of the midline and in the center of a 6 cm. transverse scar just below the hyoid bone. An odorless discharge of milky water appearance and consistency was present about the sinus opening and a dense subcutaneous band of tissue extending upward and attached to the center of the hyoid bone was palpable and followed the movements of deglutition. The physical examination was otherwise negative and a preoperative diagnosis of thyroglossal sinus was made. No methylene blue or other solution was injected into the sinus tract prior to operation as it was believed that injection of methylene blue at previous operations was done under too much pressure and that subsequent discoloration of the adjacent tissues had interfered with the proper determination of how much discolored tissue should be removed with the result that a portion of the thyroglossal tract was not excised.

Operation under closed nitrous oxide, oxygen and ether anesthesia was performed on July 7, 1943. The old scar was excised about the sinus opening and the incision was extended to the left 2 cm. to equalize both sides of the transverse incision. An indurated band of tissue was followed from the sinus opening to the center

of the hyoid bone which it appeared to penetrate but which was found to be only closely attached to the anterior surface from whence it continued upward and to the left to end in the substance of the left submaxillary gland. The submaxillary gland with the attached band of indurated tissue was removed intact and a fine rubber dam drain was placed in the submaxillary fossa. Number 80 cotton was used for ligatures and for closure. The drain was removed in eighteen hours and the skin sutures in forty-eight hours. The pathological report on the tissues removed was as follows:

Specimen consists of an oval shaped, lobulated, moderately firm, light pink mass measuring 4 by 2 by 2 cm. Extending from one margin is a sinus tract measuring 3 mm. in diameter and 5.5 cm. in length which leads to a small elliptical shaped portion of skin. The cut surface is yellowish pink and lobulated. Sections of the mass show well preserved glandular acini supported by a scanty fibrous stroma. Sections of the fistulous tract show a wall of partially hyalinized collagen within which are small areas of extravasated red blood cells. There is a small central lumen devoid of epithelial lining. Pathologic diagnosis: Submaxillary fistula.

The patient was discharged from the hospital twenty-four days after operation. Three months later there was a well healed surgical scar and there had been no recurrent drainage. Following operation the additional history was obtained that the drainage had always been more profuse while eating. It is believed that the initial lesion in this patient was a thyroglossal cyst with lateral branches from the thyroglossal tract in the area of the hyoid bone and that in the dissection of the tract the left submaxillary gland was traumatized because of efforts to remove all adjacent tissues discolored with methylene blue. In the second operation it is believed that methylene blue discoloration of tissues adjacent to the sinus tract was responsible for failure to follow the tract to the submaxillary gland.

SUMMARY

A case of external submaxillary gland fistula opening through the midline of the neck anteriorly, midway between the thyroid cartilage and hyoid bone and following operations for excision of thyroglossal cyst and excision of thyroglossal sinus, is reported. Cure was obtained by removing the fistulous tract along with the left submaxillary gland through an incision as recommended by Sistrunk for the excision of a thyroglossal sinus. The occurrence of the submaxillary gland fistula is believed to have been due to branching of the thyroglossal tract at or near the hyoid bone and to operative trauma to the left submaxillary gland as a result of discoloration of normal tissue adjacent to the thyroglossal tract by the use of methylene blue for injection into the cyst prior to the initial operation.

REFERENCES

1. Baumgartner, C. J. Branchial and thyroglossal duct cysts and fistulae in children. *Surg., Gynec. & Obst.*, 56: 948, 1933.
2. Bilchick, E. B. Salivary fistula following mastoid operation: two cured cases. *Laryngoscope*, 48: 335, 1938.
3. Brown, J. M. Branchial and thyroid duct cysts and fistulas. *Ann. Surg.*, 44: 644, 1935.
4. Clute, H. M. and Cattell, R. B. Thyroglossal cysts and sinuses. *Ann. Surg.*, 92: 57, 1930.
5. Curtis, D. Salivary fistula. *Am. J. Surg.*, 36: 122, 1937.
6. Fraser, J. E. A persistent canal of His. *J. Anat. & Physiol.*, 44: 395, 1910.
7. Gill, E. G. The management of thyroglossal cyst: report of ten cases. *Virginia Med. Monthly*, 68: 267, 1941.
8. Gross, R. E. and Connerley, M. L. Thyroglossal cysts and sinuses. *Ann. Surg.*, 92: 57, 1930.
9. Kinsella, V. J. Complete thyroglossal fistulae. *Brit. J. Surg.*, 26: 714, 1939.
10. McClintock, J. C. Lesions of the thyroglossal tract. *Arch. Surg.*, 33: 890, 1936.
11. McNealy, R. W. Cystic tumors of the neck: branchial and thyroglossal cysts. *Surg. Clin. North America*, 13: 1083, 1933.
12. Myer, H. W. Congenital cysts and fistulae of the neck. *Ann. Surg.*, 95: 1, 1932; 95: 226, 1932.
13. Parsons, W. B., Jr. Thyroglossal fistula with submental opening. *Ann. Surg.*, 97: 143, 1933.
14. Pemberton, J. deJ. and Stalker, L. K. Cysts, sinuses and fistulae of the thyroglossal duct. *Ann. Surg.*, 111: 950, 1940.
15. Russell, R. D. Cysts and fistulae of the neck. *Ann. Otol., Rhinol. & Laryngol.*, 44: 532, 1935.
16. Sistrunk, W. E. Technique of removal of cysts and sinuses of the thyroglossal duct. *Surg., Gynec. & Obst.*, 46: 109, 1928.
17. Wakeley, C. P. G. Inflammations and fistulae of the salivary glands and their treatment. *Lancet*, 2: 7, 1928.
18. Walker, V. G. The treatment of the diseases of the salivary glands. *Mil. Surg.*, 89: 656, 1941.

LYMPHOSARCOMA OF THE SMALL INTESTINE*

HARRY BERMAN, M.D. AND
Attending Surgeon, Unity Hospital
BROOKLYN, NEW YORK

CAPTAIN FRANK MAINELLA
MEDICAL CORPS, ARMY OF THE UNITED STATES

AN account of a lymphosarcoma of the small intestine, occurring in a boy seven years of age, was published in the *American Journal of Surgery* for January, 1935, by Herman Charache. Full clinical and pathological details accompanied a description of the operative treatment, and 375 similar cases found in the literature were also cited. In the March, 1943, issue of the same journal, Charache made an additional report, with the sub-title "Follow-up of Nine Years." The patient had been repeatedly examined at the Brooklyn Cancer Institute, but neither recurrence nor metastasis had ever been found. The boy was "sixteen years old, well developed, attending school, and has no symptoms." Charache concludes: "Of 404 cases of lymphosarcoma of the intestines reported in the literature, 103 had careful follow-ups. Of these, only fourteen survived for five years or more (13.6 per cent). Eight patients lived from seven to eleven years. The average duration of life was 16.7 months."

We cannot tell whether the 404 cases included that which Ritter and Shaffer reported in March, 1942, just a year previous to Charache's second report. Their patient was a man of fifty-five years, from whom "a tumor of the upper ileum" had been removed in August, 1936. The pathological report had been "malignant lymphoma of the ileum." When last seen on November 3, 1941, "the patient was in extremely good condition and free from all complaints . . . he works every day and does not observe any dietary routine." He had gained fifty-eight pounds since the operation.

Though Ritter and Shaffer state that "lymphosarcoma of the intestinal tract is not a rare disease," no other writers (including Ewing, Stout and several other distinguished pathologists) agree with them. In the abundant literature, which is in itself testimony to the rarity of the condition, because when cases are seen but seldom, those that do come under observation are usually promptly reported, one invariably finds the statement that the disease is seldom encountered. In Ritter's service at the New York Post-Graduate Hospital, during a twelve-year period eleven cases of lymphosarcoma of the intestinal tract were seen. At the beginning of the present century, Libman could find but fifty-nine authenticated instances in all previous literature, and when Menne and his co-workers again reviewed it more than forty years later they found no more than 376 cases, only one of which had been seen in their own service at the University of Oregon Medical School where more than 38,000 pathological examinations had been made. Oddly enough, they very shortly saw another case, which moved them to make a full report upon this "rare" condition.

Because we agree with the majority that the condition is rare, and likewise because so few survivals for any length of time are noted in any of the records, we believed it would be of value and interest to report a case in which the patient was operated upon by the senior author in March, 1941. Though males greatly predominate among the victims of this disease, our patient is a female; though Usher and Dixon quote a number of writers as having "found lymphosarcoma of the intestines to be more prevalent in the early decades of their patients' lives," reporting that most "were between the ages of twenty and forty years." Our patient was but eighteen

* From the Third Surgical Service, Unity Hospital, Brooklyn, New York, Dr. Daniel MacAteer, Director.

years old. Although Sugarbaker and Carver found that lymphosarcoma of the small intestine gives a better prognosis than the same neoplasm located elsewhere in the body, Stout of Columbia University, dealing with ninety cases, came to the conclusion that "if the neoplasm manifests itself before the age of twenty, the chances of long survival are minute; they are greatest if the patient has passed his fortieth year." Yet our patient, now almost twenty-two years old, is a healthy young married woman who is pregnant at this writing.

Inasmuch as "the average duration of life was 16.7 months," we believe the following case to be worthy of a place in the literature:

CASE REPORT

C. A., a white girl, aged eighteen years, was admitted to Unity Hospital, March 29, 1941, with a history of having experienced a sudden sharp pain thirty-six hours before. The pain had been continuous since and was accompanied by nausea and vomiting. Questioning elicited that she had had, during the previous six months, occasional attacks of abdominal "cramps," which had become more severe with each recurrence, and that she had lost weight during this same period. The bowel movements had been irregular, with frequent attacks of diarrhea, though no blood nor mucus had been detected in the stool. The bowels had not moved at all for forty-eight hours previous to entrance, and an enema, given on admission, had returned clear.

On physical examination the patient appeared well nourished, but was acutely ill. All reflexes were normal, as were all physical findings, save those in the abdominal region. Though there was not much rigidity, the abdomen was distended and tender all over, and a hard movable mass, about the size of a grapefruit, could be palpated to the right of the umbilicus. This mass was slightly tender.

The blood count was as follows: red blood cells 3,270,000; white blood cells 13,400; differentials: polymorphonuclears 90 per cent; lymphocytes 10 per cent; hemoglobin 44 per cent.

The preoperative diagnosis was "intestinal obstruction," and the patient was prepared for operation, glucose being administered intravenously, and gastric lavage given.

An upper right rectus incision revealed a straw-colored fluid in the peritoneal cavity, with a mass of enlarged glands matted with the small intestine, which lay about five feet from Treitz's ligament, and appeared to arise from the jejunum. Above this point the intestine was greatly distended, but below the mass it was collapsed. There were many large nodules in the mesentery supplying that portion of the bowel.

The procedure consisted in resection of a length of jejunum about eighteen inches long, which included the involved portion of the bowel as well as the glands in the mesentery. After joining the bowel by an end-to-end anastomosis, the abdomen was closed without drainage.

A transfusion of 400 cc. of citrated blood was given while the patient was still on the table; another transfusion was given two days after operation, and because she was anemic a third transfusion was thought necessary five days postoperatively. Convalescence was uneventful, and discharge took place April 12, 1941, two weeks after entrance.

The gross specimen measured 6 by 4 by 5 inches and consisted of a section of small intestine, matted together with mesentery and enlarged mesenteric glands.

Microscopically, it appeared that the entire histological structure of the section of intestine had been altered in the tumefaction, as this was composed of a diffuse growth of lymphocytic cells. These cells were irregular in size and shape, and stained unevenly; this irregular structure characterized many of the blood vessels. The reticulum was quite scant.

Pathologic diagnosis: Lymphosarcoma of the small intestine.

The advisability of giving deep *x*-ray therapy to the abdomen was considered, but was decided against because of the fear of sterilizing so young a patient. The wisdom of this decision was attested to at her last examination, January 20, 1945, when she was found in excellent health and four months pregnant.

Though several excellent reviews of the literature on lymphosarcoma of the small intestine are available, covering the period from 1900, when Libman's paper was published, it may not be out of order briefly to consider the general subject:

Incidence. Libman was the first to attempt to standardize the nomenclature of intestinal "sarcoma," and separate three cases in 1919, he designated the condition as "lymphoblastoma," and after a careful and often baffling search of the

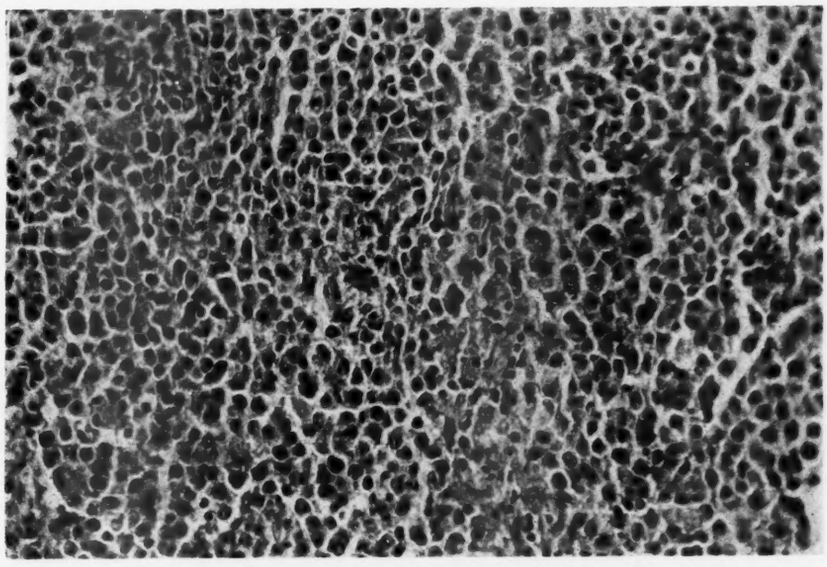


Fig. 1. Low power microphotograph; diffuse growth of lymphoid cells occupying the entire field—360 ×.

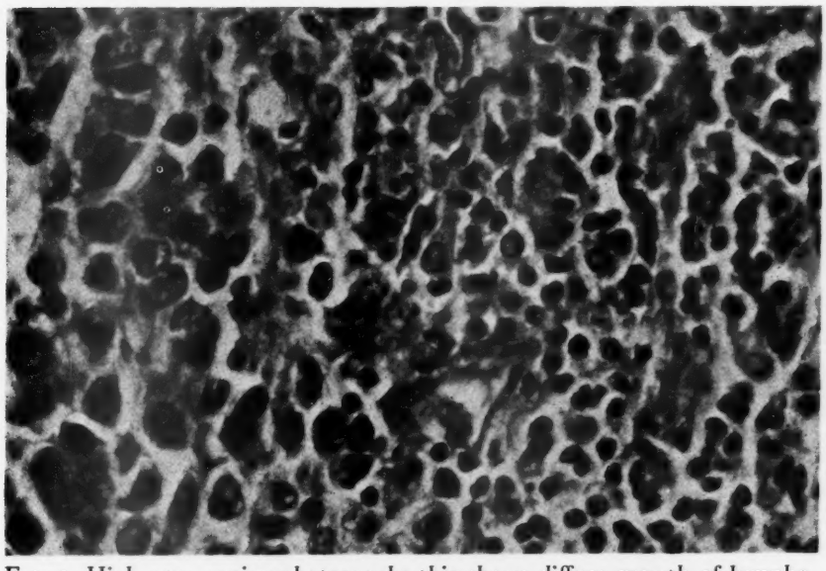


Fig. 2. High power microphotograph; this shows diffuse growth of lymphocytes, which vary in size, shape and staining characteristics—890 ×.

lymphosarcoma, the most prevalent type in the small intestine, from other forms. Speese, who wrote in 1914, found thirty-four lymphosarcomas, out of ninety-nine cases of intestinal sarcoma investigated, but Müller, who wrote six years later, discovered but one among 102 sarcomatous neoplasms. When Graves reported his literature, gave the incidence of "lymphosarcoma" as forty-eight out of 119 cases. Of more recent writers, Menne, as we have seen, could find but two among almost 40,000 pathological examinations in their own service, and records of 376 authenticated cases in all literature up to 1942. The next year, from the Mayo Clinic at

Rochester, Minnesota, Usher and Dixon quoted the figures of Ulman and Abeshouse, who collected 375 cases up to 1932, and added ten of what they termed "small round-cell sarcoma," and nine "reticulum-cell sarcoma," both types included under the general head "lymphosarcoma" of the jejunum and ileum. Thus the entire number of authenticated cases of lymphosarcoma of the small intestine is still below 400, warranting its continued classification as a "rare" disease.

Part of Intestine Most Often Affected. While our patient's lesion was in the jejunum, most authors agree that the ileum is the section of the intestine most often involved. Of recently reported cases, both those of Menne were in the terminal ileum at the ileocecal valve. The Mayo Clinic figures show that 38 per cent of all intestinal sarcomas are located in the jejunum and ileum. Ullman and Abeshouse's own patient had a lesion of the ileum, but among the 126 previous cases (of lymphosarcoma in both small and large intestines) there were: in the duodenum four; duodenum and jejunum one; jejunum seventeen: jejunum and ileum four; ileum alone thirty-six; ileocecal portion eight, and five records which merely stated "small intestines."

Metastasis and Recurrence. Inasmuch as our patient *did* have metastasis but *did not* for a five-year period, suffer recurrence, we have given especial attention to these points in our review. Of the fifty Mayo Clinic patients reported by Usher and Dixon, "All but two of the nineteen patients who had lymphosarcoma of the small bowel died of recurrence within a year." Of the entire series (which included lymphosarcoma of the cecum) "Metastasis was found to be present in 68 per cent."

These same authors remark that all the mesenteric lymph nodes examined, which numbered twenty-five, "were found to be malignantly involved," which led them to conclude that, "Apparently, all reticulum cell and small round cell sarcomata metastasize early." Cheever thought that it is not so much free-cell metastasis as direct permeation, which spreads the disease into the regional lymph nodes, and that metastases, either regional or general, may also be carried by the circulation of either blood or lymph. The chances of survival after operation seem to be in inverse ratio to the amount and extent of the metastatic involvement, which makes our own case the more remarkable, inasmuch as extensive metastasis to the mesenteric nodes was present at operation.

Diagnosis. As regards diagnosis, or rather the symptoms and roentgen findings on which it is based, there is a wide divergence of opinion among writers both recent and remote. Yet there is one point upon which Libman in 1900 and those who wrote in 1943 are in perfect agreement: The diagnosis is never made before operation or autopsy. In most of the histories it is apparent that the lesion existed a long time without making the patient aware of its presence. The usually listed symptoms of "cancer of the bowel," such as blood in the stool, alternating diarrhea and constipation, colicky pain, are notably absent. The first indications of an intestinal lesion are those of obstruction which suddenly become acute and bring the patient under observation. The most common history is one of "vague" digestive disturbance covering a long period, but gradually increasing in severity.

As regards *x*-ray findings, in Usher and Dixon's nineteen cases, "roentgenograms were made of the small intestine ('stasis ray') and in each case the lesion was visualized." These authors claim, "The characteristic dilatation of the small intestine is well visualized by this method," and cite several other writers as having urged a more extended use of "stasis ray" as favoring earlier diagnosis of intestinal lymphosarcoma. Menne states that roentgen examination generally reveals residium in the loops of the ileum, rigidity of the ileocecal valve, a filling

defect of the cecum, and distention and obstruction of the small intestine. In Benjamin and Christopher's patient, "Roentgen examination showed chronic partial small bowel obstruction of undetermined nature. . . . The physical examination was negative with the exception of visible peristalsis, distention of the upper abdomen, and marked borborygmus."

The only writer who vaunts the value of *x*-ray diagnosis is Chont who declares that, "Exact diagnosis can be made in many cases of lymphosarcoma by the motor meal. . . . In two of our three cases . . . roentgen examination was made and the origin of the tumor definitely located." He goes on to say, "Since all types of lymphosarcoma are definitely radiosensitive and respond to even small doses of radiation within a few days, this property can be used for diagnostic purposes by the 'radiation biopsy.' Applied to an abdominal mass of unknown nature, 200 r units of deep roentgen ray will produce a recognizable diminution within 72 hours, if the tumor is a lymphosarcoma." We have failed to find any reports of this diagnostic aid being used elsewhere.

Treatment. All patients save one of Chont's have been treated surgically, though many received postoperative *x*-ray. The value of radiation has not yet been established. Our patient has done well without it, yet one cannot generalize from a single instance. We must wait for more data before drawing any conclusions of value.

SUMMARY

A case of lymphosarcoma of the ileum, occurring in a girl aged eighteen years, is recorded, with a description of her condition five years after operative removal of the tumor.

The case is compared with two others reported during the past decade, wherein the patients have survived for five years or more.

A summary of the literature on lymphosarcoma of the small intestine is included, with brief discussions of incidence, pathology, diagnosis, and treatment.

REFERENCES

Banjamin, E. L. and Christopher, F. Primary lymphosarcoma of the small intestine. *Am. J. Clin. Path.*, 10: 408, 1940.

Borden, D. L. and Taylor, F. D. Primary lymphosarcoma of the small intestine. *Mil. Surg.*, 92: 255, 1943.

Cameron, A. L. Primary malignancy of the jejunum and ilium. *Ann. Surg.*, 108: 203, 1938.

Chamberlain, D. T. Malignant tumors of the small intestine. *Surg. Clin. North America*, 18: 705, 1938.

Charache, H. Primary lymphosarcoma of the intestines. *Am. J. Surg.*, 27: 171, 1935. Primary lymphosarcoma of the intestines in a boy of seven; follow up of nine years. *Am. J. Surg.*, 59: 601, 1943.

Cheever, D. Clinical aspects and treatment of primary lymphosarcoma of the stomach and intestines. *Ann. Surg.*, 96: 911, 1932.

Chont, L. K. Sarcomas of the small intestine and reference to their radiosensitivity. *Radiology*, 36: 86, 1941.

Libman, E. Sarcoma of the small intestine. *Am. J. Med. Sc.*, 120: 309, 1900.

Menne, F. R. et al. Lymphosarcoma of the intestine (2 cases). *Arch. Surg.*, 45: 945, 1942.

Müller, W. Cited by Menne et al.

Ritter, H. H. and Shaffer, J. M. Lymphosarcoma of the intestinal tract, etc. *Am. J. Surg.*, 55: 611, 1942.

Speese, J. Sarcoma of the small intestine. *Ann. Surg.*, 59: 727, 1914.

Stout, A. P. Is lymphosarcoma curable? *J. A. M. A.*, 118: 968, 1942.

Sugarbaker, E. D. and Carver, L. F. Lymphosarcoma: a study of 196 cases with biopsy. *J. A. M. A.*, 115: 17, 1940.

Ulman, A. and Abeshouse, B. S. Lymphosarcoma of the small and large intestines. *Ann. Surg.*, 95: 898, 1932.

Usher, F. C. and Dixon, C. F. Lymphosarcoma of the intestines. *Gastroenterol.*, 1: 160, 1943.

FETAL BONES PASSED IN THE FECES*

BEN FRUHLINGER, M.D.
RAY BROOK, NEW YORK

THE discharge of fetal bones by way of the intestinal tract is rarely encountered. During the period of pregnancy the fetus may come to lie in the abdominal cavity. This may be the result of a primary abdominal pregnancy, the expulsion of the fetus from the other sites of extra-uterine pregnancy, or extrusion from a ruptured uterus. Unless the fetus is removed it may undergo suppuration and the contents of the abscess may discharge into the bladder, intestines, vagina, or through the abdominal wall.[1,2,3]

The following case report describes the course of events leading up to and following the passage of fetal bones in the feces of a tuberculous patient subsequent to a therapeutic abortion:

CASE REPORT

Mrs. F., a well nourished Italian housewife, aged twenty-six, was admitted to this Hospital on December 14, 1943, complaining of severe pain in the right lower quadrant of the abdomen of two weeks' duration. The temperature was 104.8°F., respirations 32, pulse 120 per minute.

The patient said she enjoyed good health until the age of seventeen when she became ill with tuberculosis of the lungs. Four years later, in 1939, the patient was admitted to this Hospital with pulmonary tuberculosis in the moderately advanced stage. Her progress was unsatisfactory and the left lung was collapsed by an extrapleural pneumothorax. She returned home in April, 1941, with the pulmonary disease apparently arrested.

The patient attended our out-patient department and several slight extensions of the disease in the lungs were noted but further sanatorium treatment was refused until she became acutely ill following a therapeutic abortion in December, 1943.

Mrs. F. has two children, aged seven and two years. Four months previous to the birth of her first child an appendectomy was performed; recovery was uneventful. In September, 1941, a two months' pregnancy was interrupted without sequelae. In the Fall of 1942, the second child was born; following which there was a persistent, profuse, yellowish vaginal discharge, partly alleviated by douches. Menstruation, which began at the age of eleven years and was normal, returned six weeks after delivery. The last menstrual period occurred in August, 1943. In September, 1943, there was morning nausea and vomiting with vaginal bleeding for one day. On December 2nd, the patient entered a general hospital and a four-months' pregnancy was interrupted by a therapeutic abortion. The attending surgeon states that fetal parts and what appeared to be placental tissue were removed by curettage, and it was his impression that the uterus was empty when the operation was completed.

The day after the operation, the patient became feverish, her temperature was 101°F., and there were cramp-like pains and a tender mass in the right lower quadrant of the abdomen. On the same day a large amount of foul-smelling greenish material was expelled from the vaginal tract, and on the eighth postoperative day a second expulsion of similar material occurred. Two days later diarrhea was first noted and persisted for many weeks. On December 14th, the twelfth postoperative day, the patient was sent to us because of active pulmonary tuberculosis.

On admission, the patient was well nourished but appeared acutely ill. On examination, the lower portion of the abdomen was protuberant and exquisitely tender and rigid. There was no vaginal discharge; the cervix was patulous. The uterus, freely movable, lay somewhat to the right and extended to the region of the umbilicus. A soft indefinite mass was felt in the cul-de-sac. Under general anesthesia the cervix was dilated, and almost the full length of the curet could be introduced. No foreign material was recovered from the uterus, but for a few days after the operation there was a foul-smelling bloody discharge. The adminis-

* From the New York State Hospital for Incipient Pulmonary Tuberculosis, Ray Brook, N. Y.

tration of pituitrin and ergotrate caused a marked diminution in the size of the uterus.

On the eighteenth postoperative day, the patient complained of discomfort and scratching in the rectum during a bowel movement. On examination of the feces a number of small bony particles were found. Radiographic interpretation by Dr. B. Zinn—probably fetal bones.

In the early part of January, more foul-smelling green pus was expelled from the vaginal tract. From this pus, Bacillus coli were recovered in almost pure culture.

The condition of the patient remained critical and an exploratory laparotomy was performed on April 29, 1944. Numerous firm pelvic adhesions were encountered and when separated a mass, the size of a lemon, was found lying posterior to the uterus. The abscess was incised and a teaspoonful of pus was removed. A drain was placed in the pelvis and the abdomen closed. The examination of the pus showed bony particles similar to those found in the feces.

At the present time, approximately fourteen months following the therapeutic abortion, the general condition of the patient is somewhat improved; the temperature ranges between 98.6°F. and 101°F. daily, and there is a fecal fistula of the abdominal wall. The outlook for the patient is uncertain.

The bony particles from the feces and from the pus were sent to Dr. George W. Corner, Director of the Carnegie Institution of Washington, Department of Embryology in Baltimore, who submitted the following information: The specimen from the feces consisted of one ilium, one fibula, two metacarpals with two basal phalanges attached, cartilaginous head of one femur and cartilaginous head of another long bone, of a human fetus estimated to have been fifteen to seventeen weeks old. The specimen from the pus consisted of a clavicle, two mandibles and several membrane bones of the skull from a human fetus estimated to have been thirteen to fifteen weeks old. "I think the explanation of the apparent dissimilarity in the age of the two lots of fetal bones is simply that the method of determining the age by comparison with specimens of more or less accurately known age, cleared to show the bones, is not very exact. I am inclined to compromise the two estimates and say about fifteen weeks." Dr. Corner remarked that the case was most curious and interesting, and at his request the specimens were retained for the Carnegie Collection.

SUMMARY

In the case history here reported, bones of a fetus were passed in the feces, and found in the pus recovered at operation from an abscess located in the pelvis. The statement of the attending surgeon that fetal parts were removed on curettage would indicate that the pregnancy was intrauterine.

REFERENCES

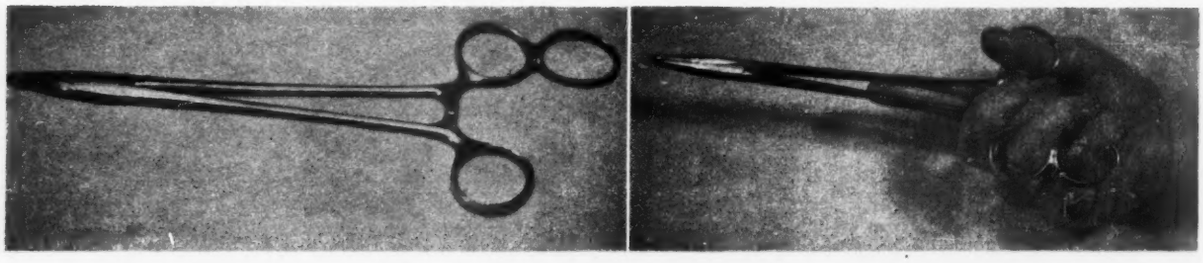
1. Cullen, Thomas. Unusual cases illustrating points in diagnosis and treatment. *Surg., Gynec. & Obst.*, pp. 260–268, March, 1915.
2. Schuman. Extrauterine pregnancy. P. 89. New York, 1924. D. Appleton & Co.
3. Cornell and Lash. *Internat. Abstr. Surg.*, p. 102, August, 1933.

New Instruments

IMPROVED NEEDLE HOLDER

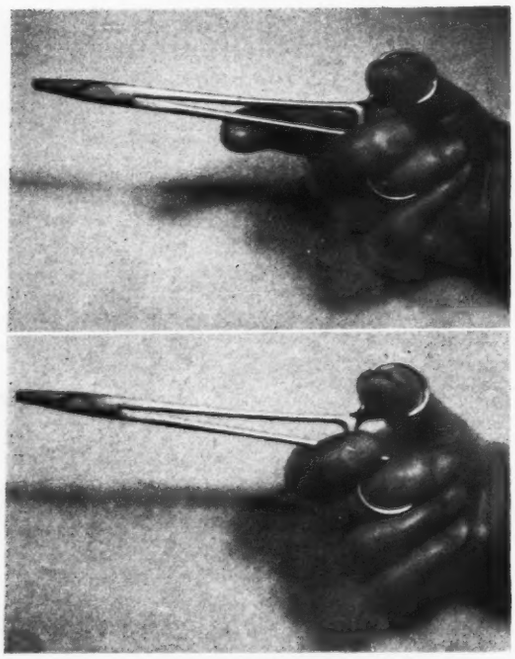
LEVON A. AKOPIANTZ, M.D.
Resident in Chest Surgery, Bellevue Hospital
NEW YORK, NEW YORK

EVOLUTIONARY upgrowth of surgical technic concomitantly effects a gradual weeding of the tools of surgery. Extravagant standardization, however, may lead to instrumental stasis and thus retard further technical advance. Therefore, surgeons should be kept constantly informed of improved or entirely new forms of instruments, so that their utilization may contribute to the pace of surgical progress.



A B

FIG. 1. A, the improved needle holder, embodying the principle developed by the author; B, the improved needle holder in correct surgical grasp.



A

B

FIG. 2. A, the standard holder as held in one manner. The fifth finger is doing no work. B, the standard holder grasped in the alternative manner. The fourth and fifth fingers are idle.

The author's improved needle holder (Fig. 1A) obtains its superior features by providing for the utilization of all five fingers of the manipulating hand. This is effected by adding a single, highly important feature: a closed ring,* which may be termed the accessory or secondary ring, is connected terminally to one of the regular rings, called the basic or primary rings, and this extension provides digital support. The instrument may be correctly grasped in the following manner: The thumb is inserted into the single ring, the fourth finger into the primary opening and the fifth finger into the secondary opening of the twin rings. The third finger is curled about the base of the stem, and the first finger loosely supports and directs the instrument head. (Fig. 1B.)

* Other possibilities include the use of a closed supplementary ring attached to each of the two basic rings, the use of one or two open rings or blunted hooks, or a combination of these.

Grasping the standard needle holder, which may be done in either one of two ways, is a maneuver familiar to the surgeon and requires no elaboration. However it may be grasped, there are fingers which are idle, providing neither guidance nor support. Grasped in one way, the use of the fifth finger is lost. (Fig. 2A.) When held in the alternative manner, two fingers —the fourth and fifth—are not utilized. (Fig. 2B.) The new design, by promoting the use of the operating hand to its fullest capacity, specifically corrects this point of deficiency.

Advantages. Through its improved design, this new holder offers four points of benefit to the surgeon:

1. A precise control and increased stability are made possible by appropriate pressure exerted at the terminus of the instrument by the small finger.

2. At the same time, pressure from the small finger complements the driving force of the needle holder, and thus creates a

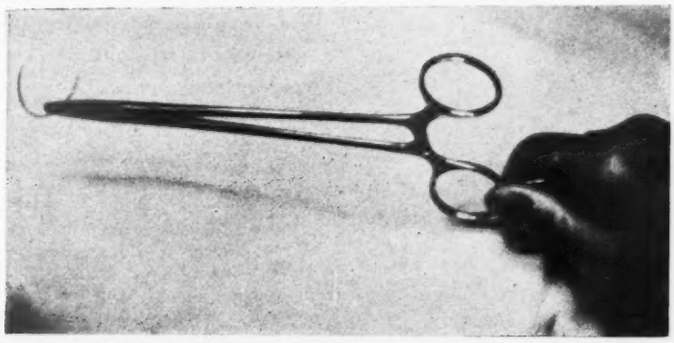


Fig. 3. Holding the instrument by its extension will increase the operating length of the needle holder.

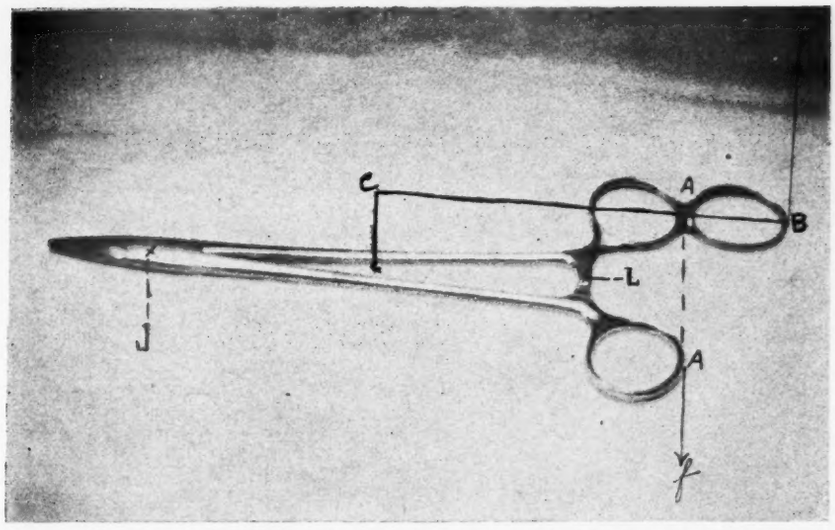


Fig. 4. As the needle holder changes during operation from a fixed or locked state to an open or mobile one, the fulcrum shifts between the joint of the instrument (J) and the locking mechanism (L). Since the distances involved are always constant and equal, a theoretical fulcrum may be considered to act at a point midway between these (C). The shorter arm will, then, act through the distance CA, and the longer arm through the distance CB. The increase in length of the arm CB is equivalent to the diameter AB of the supplementary ring. Digital pressure from the fifth finger increases force BF over that of counter force Af. Therefore, the mechanical advantage operating in this improved design to open the back will be an augmented one; and it will be regulated by the ratio of the lengths of the two arms. Thus, release of the locking mechanism is made easier.

reserve of power not attainable by the type of instrument now in use. This added strength aids in a general manner by promoting a freer injection of the needle, and specifically by facilitating propulsion of the needle through unusually dense, fibrous tissue.

3. The addition of an extra ring lengthens the holder at the discretion of the operator. (Fig. 3.) This is a particular advantage to the thoracic surgeon whose specialty often necessitates close work within the interior of the chest.

4. Of prime importance in this type of instrument, which requires constant opening and closing of its jaws, is the increased facility in the release of its locking mechanism. This is made possible through the factor of leverage inherent in the design. (Fig. 4.) Today's needle holders are provided with two arms of equal lengths. Extending one of its arms backward, as in the new type, creates what is in effect a lever system. Applied to the new instrument, the physics of the system operates to produce a mechanical advantage which is considerable and definite by magnifying the ease in the release of the locking mechanism.

It is believed that once accustomed to the facilities of this improved instrument, surgeons would find it difficult to revert to the less efficient holder now in use.

SUMMARY

An improved needle holder is described. This new design permits the utilization of all the fingers of the hand operating the instrument, and gives a more thorough control and greater stability, an increased driving force, a lengthening of the holder at the discretion of the operator, and facility in the release of the locking system.

ANAL RETRACTOR FOR USE IN ANORECTAL SURGERY

J. REMBRANDT HELFRICK, M.D.
Assistant Proctologic Surgeon, New York University Medical College Clinic
PORT WASHINGTON, NEW YORK

GOOD exposure in all types of surgery often means the difference between a well planned and easily executed operation and a well planned but difficultly executed operation. This is especially true in operations on the anorectal region.

Hullsiek, in 1937, described a malleable steel ring, 9 inches in diameter with notches at the periphery, to be used in obtaining exposure in anorectal surgery.

A ring which I have devised, as shown in Figure 1, consists of a pair of semi-anular members having their ends in end abutment with each other and connected by hinges so as to be foldable in half. Anchor springs are mounted on the top faces of the semi-anular members. Rigid steps are mounted over the adjacent ends of the semi-anular members for locking them in end abutment with each other.

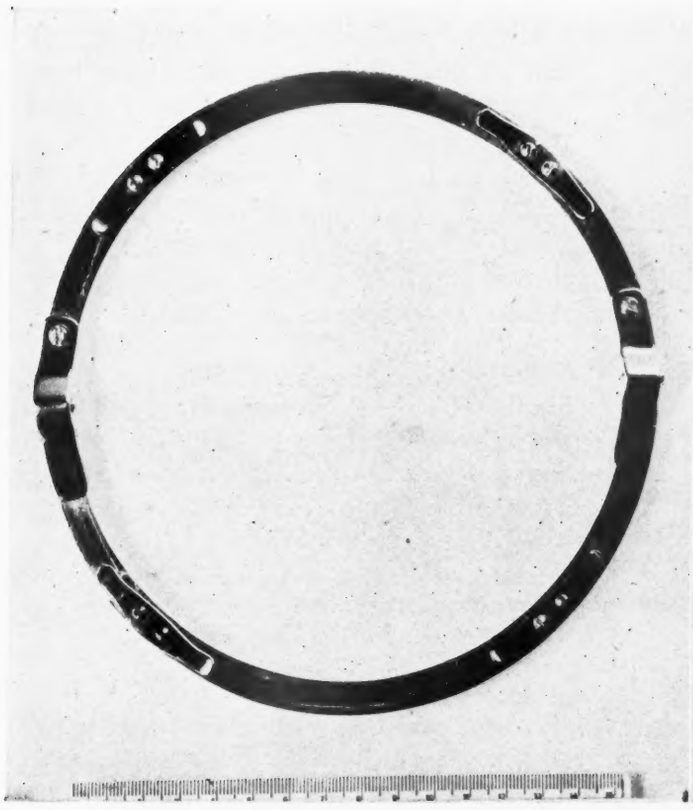


FIG. 1. Shows the circular anal retractor open and ready for use.

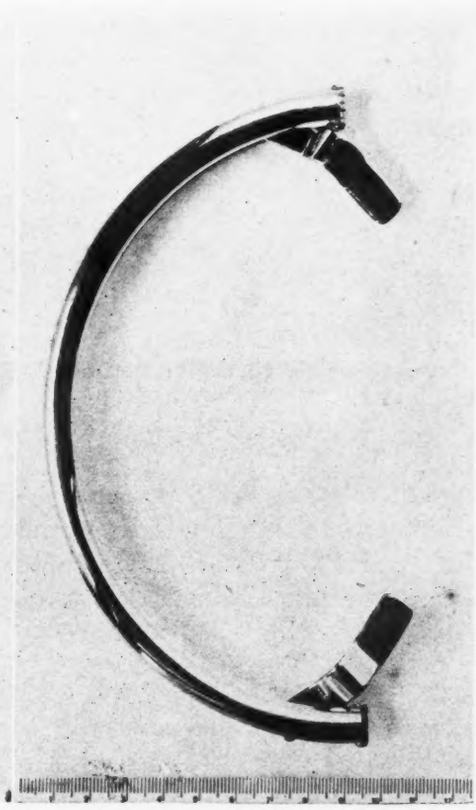


FIG. 2. Shows the circular anal retractor folded.

The features of the anal retractor may be seen in Figures 1 and 2. The method of using the anal retractor is shown in Figure 3.

The patient is placed on the table in the prone position. The table is broken slightly and a length of 3 or 4 inch adhesive is applied to each buttock just opposite the anal verge, and traction made on the adhesive which is then fastened to the table. By using this position the surgeon is not hampered by having one leg on either side of him with very little room for an assistant, as in the lithotomy position

A black silk suture is placed in each of the four quadrants of the peri-anal region, passing through the skin only. If one desires to remove the internal hemorrhoids separately, the silk can be placed through the skin tabs; or if one wishes to remove the external hemorrhoids or skin tabs in conjunction with the hemorrhoids, the silk may be placed just distal to the tabs or external hemorrhoids. Before making traction on the silk sutures, the sphincter muscle is gently dilated. Traction is made on the black silk sutures, and the silk is slipped beneath the anchor spring of the circular anoscope and tied.

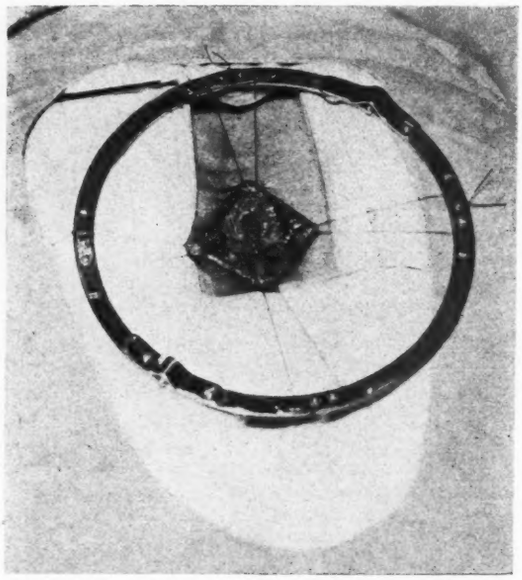


FIG. 3. Shows the circular anal retractor in use.

As can be seen in Figure 3, excellent exposure is obtained and one is able to perform the anorectal surgery without an assistant.

The features of the circular anoscope are: (1) It provides ideal exposure; (2) it can be used on any patient regardless of the size of the buttocks; (3) it obviates the necessity of one or two assistants; (4) it is small, just 6½ inches in diameter when the anoscope is opened; (5) when folded, the anoscope is compact and fits into a sterilizer very easily, and (6) it is sturdy when opened and locked.

The photographs were taken at the Meadowbrook Hospital, Hempstead, New York, through the courtesy of Dr. A. J. McRae, Superintendent of the Meadowbrook Hospital.

REFERENCE

HULLSIEK, H. E. New anal retractor. *Minnesota Med.*, 20: 300, 1937.

DEVICE TO PROTECT THE PROJECTING END OF KIRSCHNER WIRES, STEINMANN'S PIN OR EXTERNAL FIXATION PINS*

HAROLD D. CAYLOR, M.D. AND LEE WITWER
BLUFFTON, INDIANA

THE increased use of skeletal traction and particularly external fixation in the treatment of fractures presents a real problem in the protection of the portions of the pin or wire which projects beyond the fixation device or bow. Frequently a cork is stuck on the end of the pin or wire and this is soon knocked off and the patient or his attendants are very apt to injure themselves by striking the projecting end of the pin or wire.

About seven years ago Mrs. W., a member of the family of one of us (L. W.) had a fractured leg which was reduced by Kirschner wires with a skeletal traction and was held in position by incorporating these wires in a plaster of paris cast in the usual fashion. The need for protection of the ends of wires became obvious and this device is our answer to the problem.

The apparatus consists of a fiber collar approximately one-half inch in diameter and one-half inch long. This is cut from standard fiber stock. A hole is bored through the center of the stock; then the ends are dressed with a file and finished off with emory cloth. A hole is bored with a No. 25 drill and tapped to size 10 by 24 threads at right angles to the previous opening made through the fiber parallel to its long axis. In this hole a 10 by 24 Allen set screw is inserted and run down to impinge on a wire or pin and cover its projecting pointed end. (Fig. 1.) The size of the hole in the collar can be varied to fit the screw or pin.

We have been using this device for about seven years and it is eminently satisfactory.

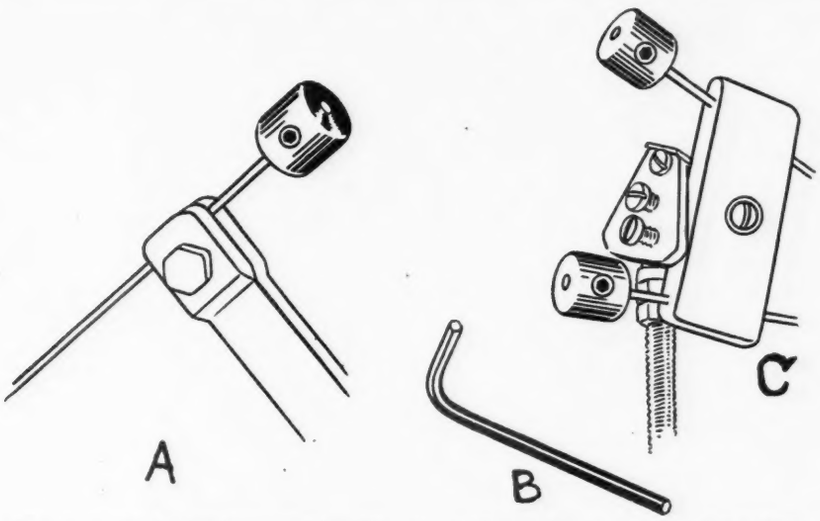


FIG. 1. A, the device in use with a Kirschner wire and bow; B, wrench for Allen screw; C, device in use on external fixation apparatus.

* From the Caylor-Nickel Clinic, Bluffton, Indiana.

STETHOSCOPE FOR DOCTORS WITH HEARING DEFECTS*

LIEUT. COL. HARRY M. KIRSCHBAUM
MEDICAL CORPS, ARMY OF THE UNITED STATES

THERE has been a good deal of advance in hard-of-hearing aids in the past twenty years. Several of these aids have been approved by the American Medical Association. There have been several attempts to make a portable stethoscope for doctors who are hard of hearing. One of these units is manufactured by the Western Electric but is quite large.

The device pictured shows a microphone of the author's invention as a part of his electrostethophone attached to an A.M.A. approved hearing aid which the doctor uses in ordinary conversation. The electrostethophone is a portable device to amplify fetal and adult heart sounds for recording on records, films or wire.

By connecting the microphone (1) at screw plug (2) to the hearing aid (3), and clipping the ear piece (4) to the top of an ordinary binaural stethoscope (5), heart sounds are transmitted to the ears when the microphone is placed over the precordium.

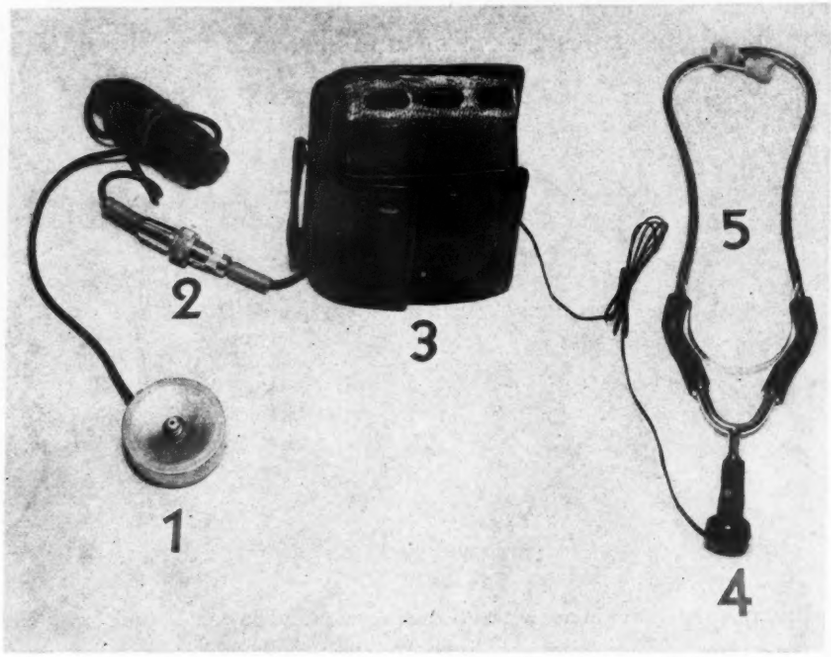


FIG. 1. Stethoscope assembled: author's microphone (1), description in paragraph 3. Stethoscope can also be used in the differentiation of murmurs.

It is obvious that the tone and volume are controlled by the dials on the amplifying unit of the hearing aid. Murmurs are amplified and the fetal heart tones can be heard.

It is stated that people exposed to gunfire noise lose some hearing ability. After the war many of our doctors involved in air, land, or sea war may have diminished hearing. This device is, therefore, offered as a simple, practical pocket unit for the physician who is hard of hearing to be used in conjunction with his hearing aid.

* Demonstrated before the Medical Section of the A. M. A., June, 1945.

HISTORICAL ASPECTS OF CARDIAC RESUSCITATION

ROBERT F. BARBER, M.D.
BROOKLYN, NEW YORK

AND

CAPTAIN JOHN L. MADDEN
MEDICAL CORPS, ARMY OF THE UNITED STATES

IN a review of the literature the earliest writings pertaining to cardiac resuscitation by manual massage are the experimental studies of the German physiologist, Schiff, in 1874. His first series of experiments were performed on dogs which were anesthetized with chloroform until the heart had ceased to beat. Subsequently and at varying intervals of time restoration of the normal beat was obtained by rhythmic manual massage of the exposed heart. This method succeeded where other measures failed. He was able to re-establish cardiac pulsation and respiratory movements up to eleven and one-half minutes after the heart had ceased to beat, although complete recovery did not ensue. His second series of experiments were performed with hearts which, after having been removed from the body, were frozen for varying and long intervals of time. Cardiac pulsations were then obtained by filling the heart with fluid and applying direct manual massage.

Fourteen years later (1898) the work of Schiff was confirmed by Tuffier and Hallion in France who performed a similar series of experiments on dogs.

Prus, in 1900, reported his results in a series of one hundred dogs in which cessation of the heart beat was obtained by the following methods: (1) chloroform, twenty-one; (2) asphyxiation, forty-four; (3) electrocution, thirty-five. In the dogs which were chloroformed the heart stopped beating at intervals of time varying from fifty seconds to twenty minutes, following the administration of the anesthetic. Upon cessation of the heart beat cardiac massage and artificial respiration were simultaneously performed at time intervals varying between fifty-five seconds and one hour. Restoration of a normal pulsation was obtained in sixteen within periods varying from thirty seconds to twenty minutes. In the dogs asphyxiated, thirty-one recovered whereas only five of those electrocuted survived. In the same year (1900) Batelli confirmed the work of Prus and demonstrated that fibrillary twitchings of the heart muscle were frequently noted in the unsuccessful cases of cardiac massage. He was successful in overcoming these fibrillary contractions by the direct application to the heart of an alternating current of 240 volts.

In 1902, Kuliabko reported a series of experiments in which he removed the hearts of rabbits and placed them in an ice chest for forty-four hours. Subsequent to this period he was able to restore rhythmic cardiac pulsations by injecting Locke's solution into the coronary arteries. In a similar manner, in rabbits which have died from a disease process, he was able to restore the beat of the heart three or four days after death. The same author also reported the successful restoration of cardiac pulsations in the heart of a three-month old infant twenty hours after death. The pulsations in this case continued for over one hour.

The work of Kuliabko was supported by Velich who in 1903 placed the isolated heart of a dog in snow for six hours. Following this he was able to produce auricular and ventricular contractions by massage alone. He repeated this success in another heart which was placed in snow for eighteen hours and then frozen in salt solution for another two hours.

It was in the same year (1903) that Bourcart succeeded in restoring the normal cardiac rhythm in a dog by means of subdiaphragmatic massage of the heart. Massage was begun five minutes after cessation of the heart beat which occurred under chloroform anesthesia. The recovery

of the animal was complete after massage had been performed for three minutes.

During this period the work on caridac resuscitation was not confined to the experimental laboratory. Niehaus, of Berne (1889), was the first to attempt resuscitation of the human heart by manual massage. This was unsuccessful and not reported. The first case reported was that of Tuffier and Hallion (1898). This, too, was unsuccessful.

Maag (1900) was able to re-establish cardiac pulsations and spontaneous respirations both of which persisted for eleven hours. This was the first report of a partial success.

Starling and Lane (1902) using the subdiaphragmatic method of massage first reported a completely successful case of resuscitation of the human heart. Spontaneous respirations were not established until twelve minutes following the return of a normal cardiac rhythm. This success was preceded by that of Igelsbrud (1901), but it was not reported until three years later (1904).

Similarly Gray (1902), Cohen (1903), Sencert (1905), Conkling (1905), Smith (1905) and Ramsay (1906) reported cases in which complete recovery occurred following cardiac massage.

Green (1906) in an exhaustive review of the world literature was able to collect forty cases in which manual massage of the heart had been performed; thirty-six of these had been previously reported. In this series nine (22.5 per cent) complete recoveries were obtained and eight (20 per cent) partial successes. The latter included those cases in which the pulse and respiration were restored for variable periods of time but ultimately ended fatally.

In 1909, Von Cackovic collected forty-six cases. This report included three of his own with complete recoveries in two.

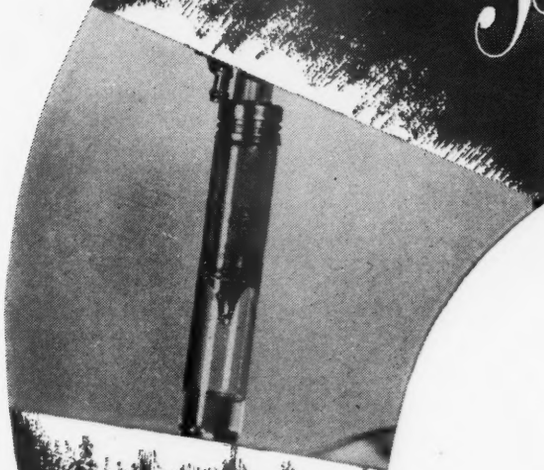
White (1909) added ten cases to the forty reported by Green. In ten (20 per cent) of these complete recovery was obtained and fourteen (28 per cent) were partially successful.

Bost made a collective review of the literature in 1918, and again in 1923, reporting sixty and seventy-five cases, respectively. Sixteen of seventy-five (21 per cent) recovered completely and twenty-three (30.6 per cent) were partially successful.

Lee and Downs (1924) added twenty-four cases to the seventy-five previously reported by Bost, including the presentation of a successful case of their own. This made a grand total of ninety-nine cases reported up to this time with complete recovery in twenty-five.

In an extensive review of the world literature from 1924 up to the present time we have been able to collect forty-four more cases with complete recoveries in twenty-three (52 per cent), and partial recoveries in sixteen (36 per cent). This brings the total number of cases reported to one hundred and forty-three, forty-eight (33 per cent) of which have been completely successful.

ANOTHER *Baxter* SAFEGUARD



The Baxter Filterdrip

Eliminating a separate filtering operation, the Filterdrip simultaneously removes clots, fibrin, and particulate matter and provides an efficient sight gauge for regulating the flow of blood, plasma, or serum.

Such safeguards, and Baxter's simple, convenient technique, contribute to a trouble-free parenteral program. No other method is used by so many hospitals.

Manufactured by

BAXTER LABORATORIES, INC.

Glenview, Illinois; Acton, Ontario; London, England

Baxter
PIONEERS IN
PARENTERAL THERAPY

Distributed east of the Rockies by

AMERICAN HOSPITAL SUPPLY CORPORATION

CHICAGO • NEW YORK

Produced and distributed in the Eleven Western States by DON BAXTER, INC., Glendale, Calif.

● The analgesic power of DEMEROL hydrochloride ranks between morphine and codeine, but carries with it considerably less risk of addiction. The majority of patients do not acquire tolerance. The incidence of euphoria produced by DEMEROL hydrochloride, in the presence of pain, is only 10 per cent. Furthermore, respiratory depression from DEMEROL hydrochloride is very uncommon, and the drug has no constipating effect.

Spasmolytic and sedative action

In addition to its marked analgesic potency, DEMEROL hydrochloride possesses spasmolytic action similar to that of atropine and papaverine, as well as mild sedative effects.

DEMEROL

TRADEMARK REG. U. S. PAT. OFF. & CANADA

HYDROCHLORIDE

BRAND OF MEPERIDINE HYDROCHLORIDE
(ISONIPECAINE)

ANALGESIC • SPASMOLYTIC • SEDATIVE

SUBJECT TO REGULATIONS OF THE FEDERAL BUREAU OF NARCOTICS

Winthrop Chemical Company, Inc.

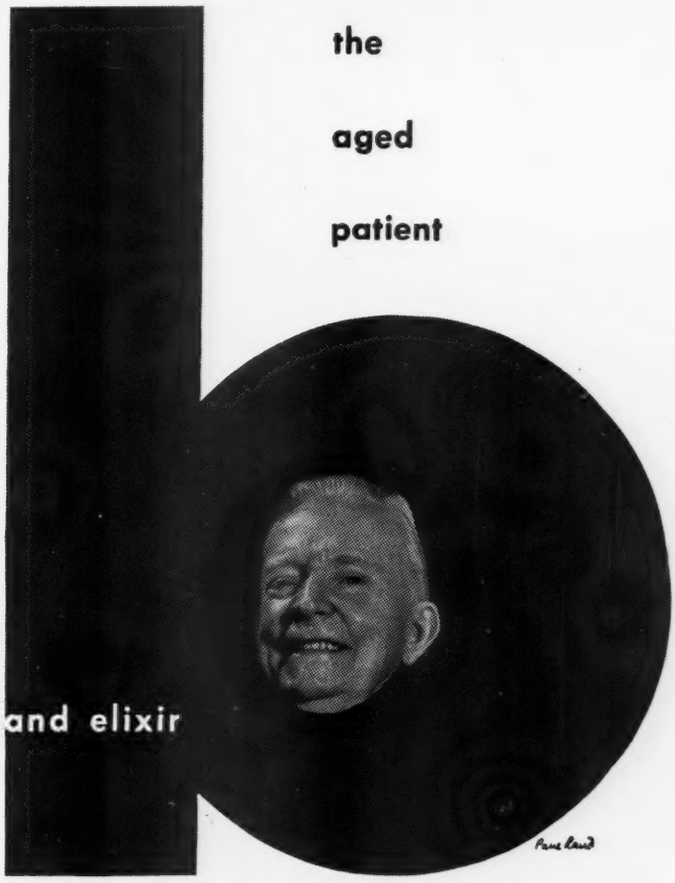
PHARMACEUTICALS OF MERIT FOR THE PHYSICIAN • NEW YORK 13, N. Y. • WINDSOR, ONT.

when persistent depression settles upon

the

aged

patient



benzedrine sulfate
(racemic amphetamine sulfate, S. K. F.)

tablets and elixir

Old age sometimes brings a severe and lasting depression, marked by self-absorption, withdrawal from former interests and loss of capacity for pleasure. This characteristic depression often aggravates underlying pathology by interfering with exercise, appetite and sleep.

Because of its power to restore mental alertness and zest for living, Benzedrine Sulfate is of special value in the management of depression and anhedonia in the aged. Obviously, careful observation of the aged patient is desirable; and the physician will distinguish between the casual case of low spirits and a true and prolonged mental depression. The dosage should be adjusted to the individual case.

Smith, Kline & French Laboratories, Phila., Pa.

double trouble...

Where throbbing pain gives rise to nervous disquietude...as in migraine, neuralgia or dysmenorrhea...both pain and nervousness respond to the combined sedative and analgesic actions of 'PERALGA'* Analgesic Sedative.

Enabling the physician to restore comfort and confidence to the distressed patient pending the determination of specific etiological factors, 'PERALGA' Analgesic Sedative offers a pronounced analgesic effect with mild sedative action, yet, is nonnarcotic. Its efficacy mediated through such classic ingredients as acetophenetidin, acetylsalicylic acid and barbital, 'PERALGA' Analgesic Sedative has no depressing aftereffects and does not restrict the patient's usual activities. It is also of established value preoperatively to allay nervousness and apprehension, and postoperatively to relieve pain.

In 7-grain tablets, boxes of 6, 12, 50, 100, 500; as powder, in bottles of ½ oz., 1 oz.

*Trademark Reg. U. S. Pat. Off.

'PERALGA'

ANALGESIC SEDATIVE

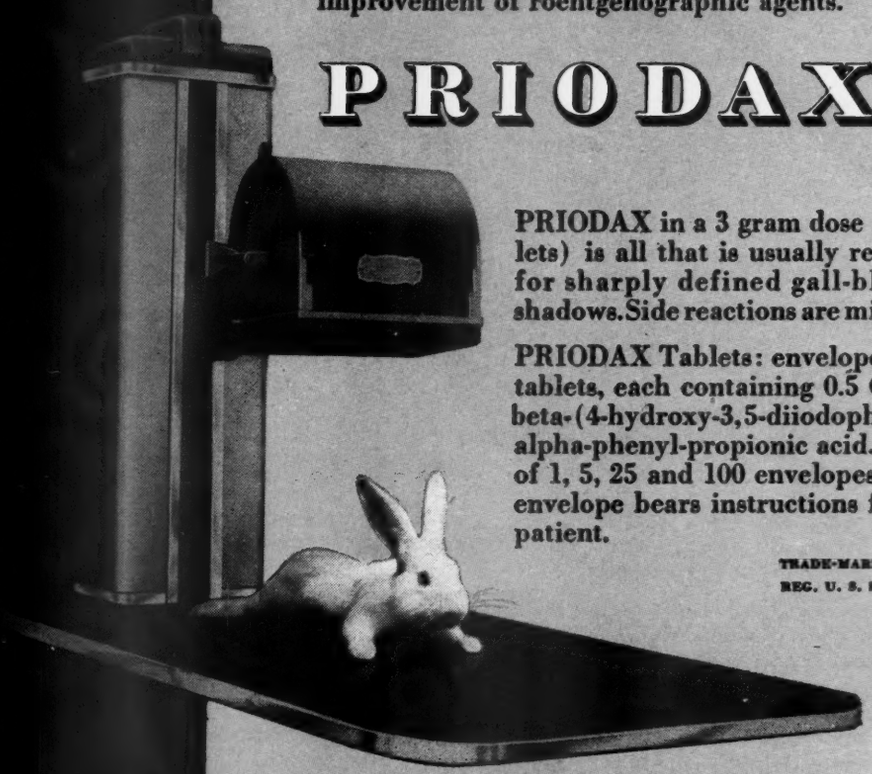
SCHERING & GLATZ, INC., *a subsidiary of*

WILLIAM R. WARNER & CO., INC., 113 W. 18TH ST., NEW YORK 11, N.Y.

Shooting rabbits

Inside the Schering laboratories, we "shoot" rabbits with x-rays — just one of the many exacting tests for efficiency of x-ray contrast media employed in our laboratories during the development and improvement of roentgenographic agents.

PRIODAX



PRIODAX in a 3 gram dose (6 tablets) is all that is usually required for sharply defined gall-bladder shadows. Side reactions are minimal.

PRIODAX Tablets: envelope of six tablets, each containing 0.5 Gm. of beta-(4-hydroxy-3,5-diiodophenyl)-alpha-phenyl-propionic acid. Boxes of 1, 5, 25 and 100 envelopes. Each envelope bears instructions for the patient.

TRADE-MARK PRIODAX
REG. U. S. PAT. OFF.

Schering CORPORATION • BLOOMFIELD, N. J.

MAKING YOUR WISHES COME TRUE...

One wish has been fulfilled. Won by 3½ years of deadly struggle. With God's help, we have prevailed.

Now we have a chance to make another wish come true. For most of us, the outlook is a bright one. If we will simply use the brains, the will, the energy, the enterprise . . . the materials and resources . . . with which we won our war, we can't fail to win the peace and to make this the richest, happiest land the world has known.

Your wishes have been wrapped in that bright outlook. Your wish for a cottage by a lake. For your boy's college education. For a trip you long to take. For a "cushion" against emergencies and unforeseen needs.

You can make those wishes come true by buying bonds today . . . buying them regularly . . . and holding on to them in spite of all temptation.

There's no safer, surer investment in the world. You can count on getting back $4 for every $3 you put in E Bonds—as surely as you can count on being a day older tomorrow.

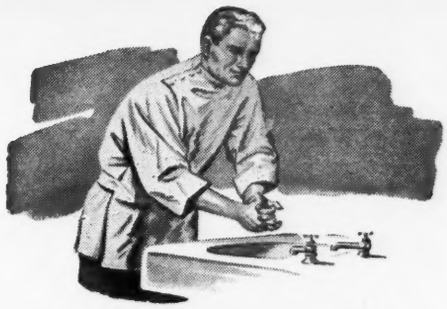
So why not be patriotic and smart at the same time?

FULFILL YOUR WISH—BUY EXTRA BONDS IN THE GREAT VICTORY LOAN!

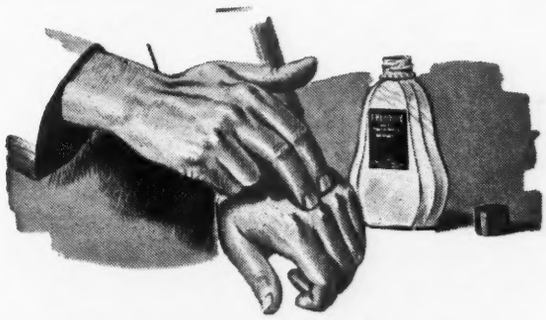
THE AMERICAN JOURNAL OF SURGERY, INC.

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

FREQUENT WASHING MAY LEAD TO HAND IRRITATION!



Frequent washing may leave your hands red and rough . . . etch tiny fissures where harmful organisms can gain entrance.



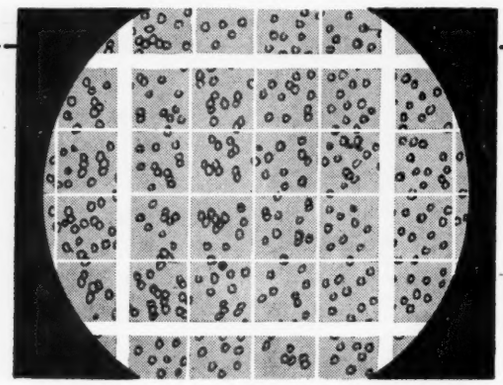
Applied *before* washing, TRUSHAY forms an invisible film which helps protect against the harsh effects of cleansing agents . . . guards hands by helping to keep skin normal and unbroken!

TRUSHAY does not cause unnatural stickiness

A Product of BRISTOL-MYERS COMPANY, 19NFW. 50th St., New York 20, N. Y.

Number 3 of a Series

IN ANEMIA OF CHRONIC BLOOD LOSS



In the management of chronic blood loss, therapy designed to support red cell and hemoglobin formation is essential. Iron must be supplied to correct hypochromia; liver and the B vitamins bolster an overworked bone marrow in the production of red cells. The combination is more effective than iron alone.

HEPATINIC

presents iron in readily assimilable ferrous form, together with Crude (Unfractionated) Liver Concentrate and Vitamin B Complex.

Crude (Unfractionated) Liver Concentrate is prepared so that it retains the erythropoietic and nutritional principles of whole liver, which are lost in the highly refined concentrates. Furthermore, it is subjected to enzymatic digestion to provide maximum assimilation and prompt therapeutic response.

The appealing and palatable taste of Hepatinic assures patient acceptance and particularly recommends the product for pediatrics.

FORMULA: Each fluidounce Elixir Hepatinic contains:

Ferrous Sulfate 12 gr., Crude (Unfractionated) Liver Concentrate (equivalent to 660 gr. fresh liver) 60 gr. Thiamine Hydrochloride 2 mg., Riboflavin 4 mg., Niacinamide 20 mg., together with pyridoxine, pantothenic acid, choline, folic acid, vitamin B_{10}, vitamin B_{11}, biotin, inositol, para-amino-benzoic acid, and other factors of the vitamin B complex.

Bottles of one pint and one gallon. Tasting samples on request.

McNeil Laboratories
INCORPORATED
PHILADELPHIA • PENNSYLVANIA

THE ADVANTAGES OF LIPIODOL DIAGNOSIS

In Myelography

In the roentgen exploration of the spinal canal, Lipiodol—the pioneer contrast medium—distinctly aids in determining and localizing lesions that compress or impinge upon the cord. Its fluidity permits easy introduction through an ordinary spinal needle . . . its high opacity renders pathologic indentations clearly visible . . . its viscosity allows it to be positioned at any desired level, time and again, merely by tilting the x-ray table. Lipiodol does not mix with the spinal fluid; hence it is readily aspirated on completion of the examination.

Thus Lipiodol reveals whether a tumor is extradural, subdural, or intramedullary; it localizes the level of cord compression; induced excursion up and down the canal demonstrates the presence of multiple lesions, such as subdural meningioma and concomitant prolapsed disks. Anomalies are readily recognized.

Lipiodol is sterile and bland, therefore rarely irritating. Its iodine is firmly fixed to poppyseed oil by chemical union. For spinal use, two forms are available: Lipiodol Descendant (sp. gr. 1.34), containing 40% iodine, and Lipiodol Ascendant (sp. gr. 0.99), containing about 10% iodine. Each is supplied in 5 cc. ampuls.

E. FOUGERA & CO., INC.
75 Varick Street ***Distributors*** **New York 13, N. Y.**

Lipiodol

(LAFAY)

Lipiodol, made in the U. S. A., is available in a variety of ampul sizes and in 20-cc. rubber-stoppered vials.

ACCEPTED AMERICAN MEDICAL ASSN. Council on Pharmacy and Chemistry

THE NEW YORK POLYCLINIC
MEDICAL SCHOOL AND HOSPITAL
(ORGANIZED 1881)

(The Pioneer Post-Graduate Medical Institution in America.)

UROLOGY

A combined full time course covering an academic year (8 months). It comprises instruction in pharmacology; physiology; embryology; biochemistry; bacteriology and pathology; practical work in surgical anatomy and urological operative procedures on the cadaver; regional and general anesthesia (cadaver); office gynecology; proctological diagnosis; the use of the ophthalmoscope; physical diagnosis; roentgenological interpretation; electrocardiographic interpretation; dermatology and syphilology; neurology; physical therapy; continuous instruction in cystoendoscopic diagnosis and operative instrumental manipulation; operative surgical clinics; demonstrations in the operative instrumental management of bladder tumors and other vesical lesions as well as endoscopic prostatic resection.

ANESTHESIA

The course includes general and regional anesthesia, with special demonstrations in the clinics and on the cadaver of caudal, spinal, field blocks, etc. Instruction in intravenous therapy, oxygen therapy, resuscitation, aspiration bronchoscopy.

FOR INFORMATION ADDRESS

MEDICAL EXECUTIVE OFFICER, 345 West 50th Street, NEW YORK 19

COOK COUNTY
GRADUATE SCHOOL OF MEDICINE
(In affiliation with COOK COUNTY HOSPITAL) Incorporated not for profit

Announces continuous courses

SURGERY—Two Weeks Intensive Course in Surgical Technique starting October 8, October 22, and every two weeks during the year. One Week Course Surgery of Colon and Rectum November 5. 20 Hour Course Surgical Anatomy October 8.

GYNECOLOGY—Two Weeks Intensive Course October 22.

OBSTETRICS—Two Weeks Intensive Course October 8.

ANESTHESIA—Two Weeks Course Regional, Intravenous and Caudal Anesthesia.

ROENTGENOLOGY—Courses in X-ray Interpretation, Fluoroscopy, Deep X-ray Therapy every week.

UROLOGY—Two Weeks Course and One month Course every two weeks.

CYSTOSCOPY—Ten Day Practical Course every two weeks.

GENERAL, INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE, SURGERY AND THE SPECIALTIES

Teaching Faculty—Attending Staff of

COOK COUNTY HOSPITAL

Address: Registrar, **427 South Honore Street, Chicago 12, Illinois**

COPPERIN

THE SAFEGUARD AGAINST

Pre and Postoperative

IRON-DEFICIENCY ANEMIA

Copperin offers definite pharmacological advantages. Because in Copperin iron ammonium citrate is combined with the catalyst copper sulphate, there is a greater utilization of iron by the system.

For this reason the iron content per capsule is purposely small—32 mgm.—but wholly adequate.

As there is no stomach irritation or constipating effect from Copperin it is exceptionally well adapted to routine use.

In two strengths: Copperin "A" for adults; Copperin "B" for children.

Liberal samples gladly sent on request

MYRON L. WALKER COMPANY, Inc.
Mount Vernon New York

EFFECTIVE
PALATABLE
CONVENIENT
SAFER
SULFADIAZINE
THERAPY

SYRUP
VANA·DIAZINE
(SUSPENSION OF SULFADIAZINE)
with
THIAMIN
CHLORIDE

There is no more agreeable, easier way to administer adequate dosage of sulfadiazine than vanilla flavored VANA-DIAZINE . . . particularly in infants and children, women, and the aged.

***High dosage of vitamin B_1* helps avert nausea, vomiting, anorexia, and to meet the increased metabolic need for thiamine, often encountered in conditions requiring sulfonamides.**

The urinary alkalizing effect of one-sixth molar sodium lactate in VANA-DIAZINE aids in averting sulfonamide crystalluria and urinary tract injury.

Wherever sulfadiazine is indicated, in Pneumococcic, Streptococcic, Meningococcic, Gonococcic infections.

Each fluidounce of VANA-DIAZINE represents Sulfadiazine 40 grains, Thiamin Chloride 24 mg., one sixth Molar Sodium Lactate in an invert sugar base.

Write for Samples and Literature

VITAMIX CORPORATION
632 Race Street Philadelphia, Pa.

DEKNATEL SURGICAL NYLON

BRAIDED AND TREATED

—Not affected by Digestive or Tissue Enzymes

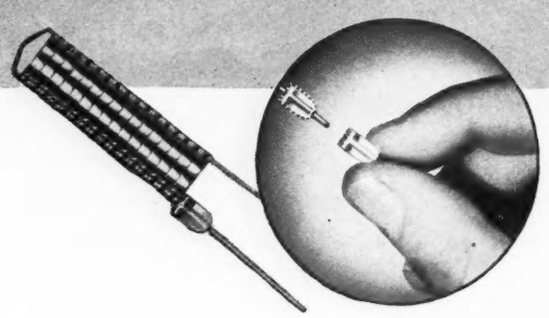
Neutral, non-absorbable suture—unusually smooth—uniform in gauge and tensile strength. Action in tissues similar to silk. Stable fibres. Unusual working tensile strength.

Moisture resistant	Splinterless
Serum resistant	Does not swell
Wholly synthetic	Very pliable
Chemically inert	Re-sterilizable

DEKNATEL QUEENS VILLAGE 8, (L. I.) NEW YORK

PROPPER BRAND MICHEL WOUND CLIPS

have a *Plus* value



Manufactured of finest 18% non-corrosive nickel silver, these precision-made clips are unexcelled for uniformity of angulation, needle-sharp points, desired bending strength and durability.

AVAILABLE IN 11, 14, 16, 18 AND 22 MM. SIZES

Your dealer can supply you

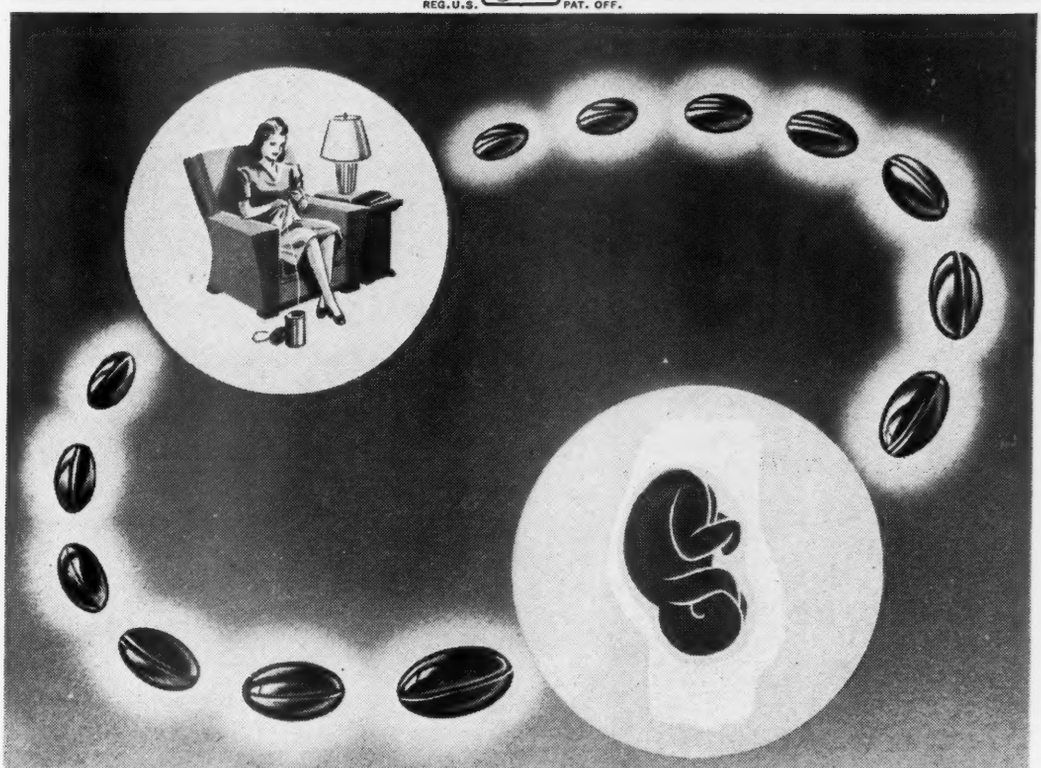
They feature a patented "Anchor"

Affixed to one end of the gang wire, this practical innovation offers the following advantages—

1. The "Anchor" may readily be slid off the wire or repositioned by finger pressure . . . the required number of clips freely removed . . . remaining clips retain their factory-new characteristics for future use.
2. The gang wire need never be bent to disengage or secure remaining clips, thus no series of humps are developed in the wire which might hinder removal of further needs.
3. As no snipping of wire is necessary, there is virtually no possibility of pricking the finger or puncturing a rubber glove on resultant burrs.

PROPPER MANUFACTURING CO., 10-34 44th DRIVE, LONG ISLAND CITY 1, N. Y.

Wyeth
REG. U.S. PAT. OFF.



Life with Mother

CAROTENE SAFEGUARDS
BOTH MOTHER AND CHILD

Vitules*

The Only Multivitamin Capsule Containing CAROTENE

FOR MOTHER—a generous supply of all essential vitamins, well above the minimum daily requirements.

FOR BABY—an adequate supply of CAROTENE, the important source of vitamin A for the fetus, as well as substantial amounts of other essential vitamins.

*REG. U. S. PAT. OFF.

VITULES

IMPROVED FORMULA VITAMIN CAPSULE
Supplied in bottles of 30 and 100

Wyeth

WYETH INCORPORATED • PHILADELPHIA 3 • PENNSYLVANIA

ACCEPTED
AMERICAN MEDICAL ASSN
Council on Pharmacy and Chemistry

PREFERRED FOR SURGICAL ANTISEPSIS

Non-toxic

A potent bactericide

Virtually non-irritating

Prolonged effectiveness

in presence of serum

℞ Azochloramid

Brand of Chloroazodin U.S.P.

THE STABLE CHLORAMINE FOR "DAKINIZATION"

Trademark "AZOCHLORAMID" Reg. U.S. Pat. Off.

ARMY E NAVY W&T

WALLACE & TIERNAN Products, Inc. • Belleville 9, N. J.

Wendel's CATHETER RECEPTACLE

FOR THE WELFARE AND COMFORT OF THE PATIENT

C6002—Wendel's Catheter Receptacle (patent pending) with adjustable Leather Headband. $7.50 each

This appliance has been designed to provide a light, secure, comfortable support for the nasal tube, which is used in continuous gastric lavage, continuous oxygen and heliun-oxygen therapy or any type of procedure which may require the continual use of a nasal catheter.

Because of its construction, this appliance allows the patient to wear glasses comfortably, wash his face without removing or dislodging the catheter and eliminates the discomfort so often caused by adhesive allergy, loosening of adhesive tape from perspiration; or, in men, the discomfort caused by adhesive in the beard.

This appliance allows for adjustment according to the size of the head so that it may be used for a child or adult. This adjustment principle permits application of the appliance with enough security to warrant its use on irrational patients with greater success than heretofore obtained.

This appliance may also be used as a retainer for in-dwelling catheters. It can easily be strapped to the thigh. There is not the inconvenience of adhesive tape on the external genitalia and pubic hair.

Soft Rubber Tubes and Catheters up to size 16 can be used with this Apparatus.

FRED. HASLAM & CO. INC. 83 Pulaski Street, Brooklyn, 6, N. Y.

Four Important Advantages Essential in Postsurgical Feeding

The dicta of the early postsurgical diet, based on the aim of nutritional maintenance so that reparative processes may not be impeded, may well be summed up in these four points: balanced content of essential nutrients—blandness—easy digestibility—and appetite appeal. Cereals, whether ready-to-eat or to-be-cooked, meet these requirements so advantageously that they are usually the first solid food offered the postsurgical patient.

The dish of cereal (whole-grain, enriched, or restored to whole-grain values of thiamine, niacin, and iron), milk, and sugar, presents a nutritional composition bettered by few foods. It provides biologically adequate protein, carbohydrate, easily emulsified fat, B vitamins, and minerals.

It is thoroughly bland and easily digested. Except for cereals purposely made different through bran content, it is digested virtually quantitatively, giving the patient the full benefit of the amount ingested.

The wide variety of cereals available permits of variation in taste and form which prevents cloying the appetite, especially when both hot and cold cereals are served.

The nutritional contribution made by 1 oz. of cereal, 4 oz. of milk, and 1 teaspoonful of sugar, is shown by this table of composite averages:

Calories	**202**
Protein	**7.1 Gm.**
Fat	**5.0 Gm.**
Carbohydrate	**33 Gm.**
Calcium	**156 mg.**
Phosphorus	**206 mg.**
Iron	**1.6 mg.**
Thiamine	**0.17 mg.**
Riboflavin	**0.24 mg.**
Niacin	**1.4 mg.**

The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

C E R E A L I N S T I T U T E, INC.

135 SOUTH LA SALLE STREET · CHICAGO 3

Attaining Perfection...

The attainment of perfection is not a simple or easy task. Only those who apply themselves unreservedly can hope to reach this goal.

At Harrower we are pledged to continuous application of rigid scientific and technical controls in the development of specialized products which will continue to merit the increasing confidence of the medical profession.

You can specify Harrower with the confidence that your patients will receive the full benefit of the medicament prescribed.

The HARROWER LABORATORY, Inc.

GLENDALE 5 · CALIFORNIA · NEW YORK 7 · CHICAGO 1 · DALLAS 1

Effective, Convenient and Economical

THE effectiveness of Mercurochrome has been demonstrated by more than twenty years of extensive clinical use. For professional convenience Mercurochrome is supplied in four forms— Aqueous Solution in Applicator Bottles for the treatment of minor wounds, Surgical Solution for preoperative skin disinfection, Tablets and Powder from which solutions of any desired concentration may readily be prepared.

Mercurochrome

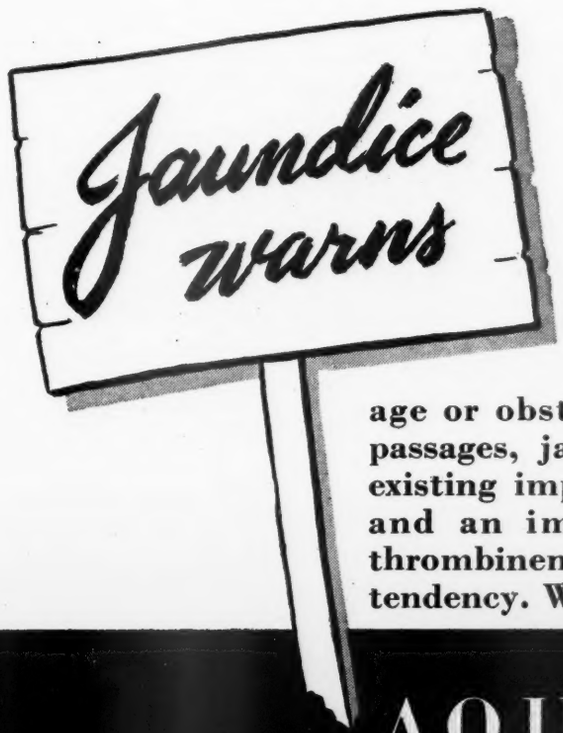
(H. W. & D. brand of merbromin, dibromoxymercurifluorescein-sodium)

is economical because stock solutions may be dispensed quickly and at low cost. Stock solutions keep indefinitely. Mercurochrome is antiseptic and relatively non-irritating and non-toxic in wounds.

Complete literature will be furnished on request.

HYNSON, WESTCOTT & DUNNING, INC.

Baltimore, Maryland



When due to intrinsic liver damage or obstruction of the bile passages, jaundice warns of an existing impaired liver function and an impending hypoprothrombinemia and hemorrhagic tendency. Water-soluble

AQUINONE

AQUAKAY Bischoff

(2-methyl-1, 4 naphthoquinone—menadione) are specifically indicated in the medical management of such conditions and in the preoperative, operative and postoperative care of jaundiced patients.

Aquinone in ampules of 1 mg.; Aquakay in tablets of 0.5 mg. and 2.0 mg.

Bischoff

ERNST BISCHOFF COMPANY, INC. • IVORYTON, CONN.

IODINE . . . A PREFERRED ANTISEPTIC

Through the Years . . .

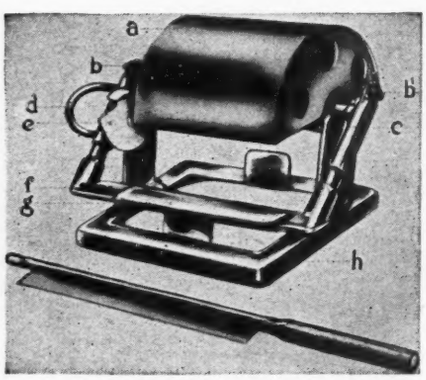
It is logical that Iodine has been an antiseptic of choice for so many years . . . because of its bactericidal efficiency and its lasting effectiveness. The action of Iodine is rapid and trustworthy.

Iodine is preferred by many physicians in pre-operative skin disinfection and in treatment of wounds, cuts and abrasions.

★ **IODINE** *Foe of Infection* ★

Iodine Educational Bureau, Inc. 120 Broadway, New York 5, N. Y.

PADGETT-HOOD DERMATOME

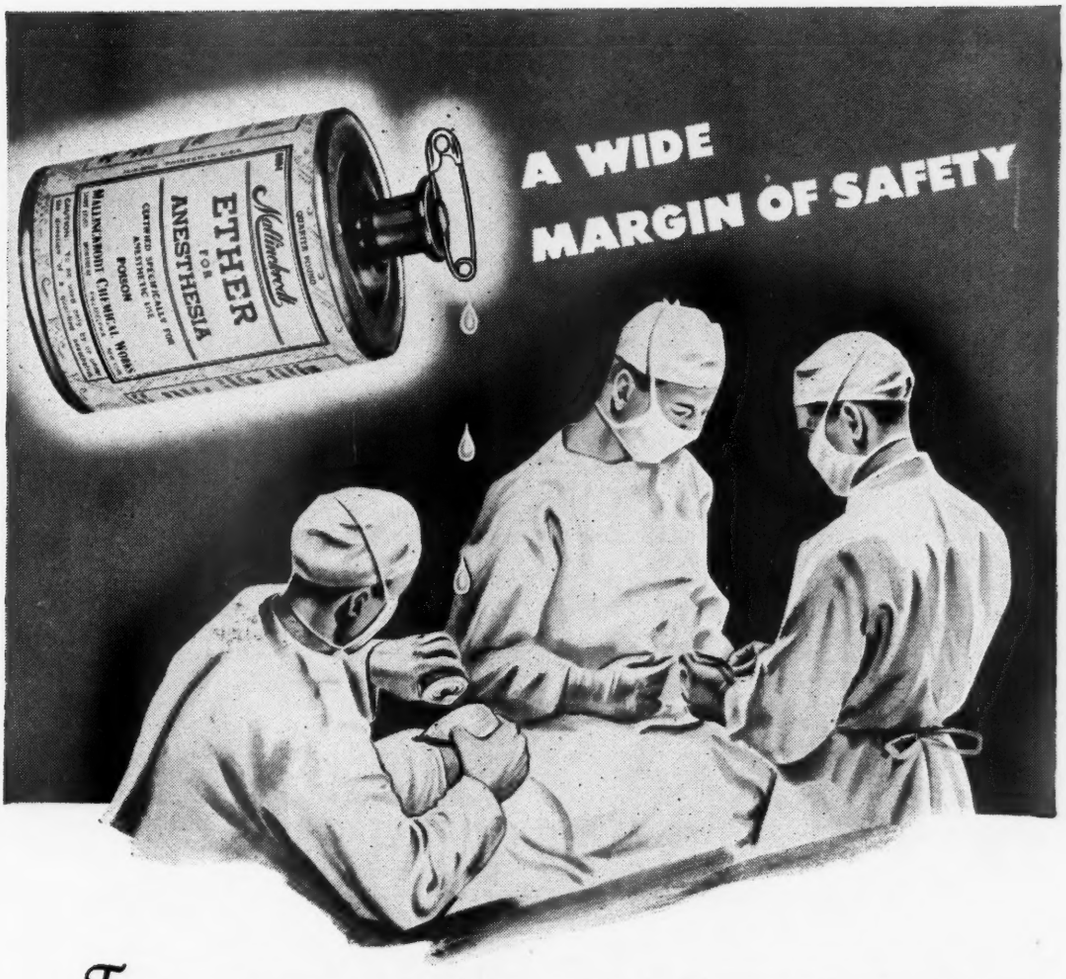


By means of this unique instrument a sheet of skin of uniform thickness may be cut at any predetermined level the size of the drum (4 x 8 inches) from any area of the body. Those who have used the dermatome state that it simplifies the technique and enlarges considerably the whole field of skin grafting. Same blade used for drum may be placed in handle and used to cut razor grafts or for honing blade. Rubber cement for the drum and donor area also is available, as well as a knife sharpening service.

Manufactured and sold by

The Kansas City Assemblage Company

609 EAST 17th ST., KANSAS CITY 8, MO.



Two of America's leading anesthesiologists recently stated: "Drop ether still remains one of our safest anesthetics."[1]

Safety of the anesthetic agent is of particular importance for the patient in shock. In such cases, "the safest agent, for experienced and inexperienced anesthetists alike, is ether. Its value has been proved in nearly 100 years of continuous use during which many million operations must have been performed. It is the agent with which we have the most experience, which has the widest margin of safety, which has been most carefully investigated both in the laboratory and under clinical conditions."[2]

For extensive procedures in which regional anesthesia is not applicable, ether and oxygen administered through a gas machine is the anesthetic of choice The method used should be intratracheal, as it will enable the anesthetist to keep the operative field clear for the surgeon, and eliminates all difficulty in maintaining a free airway.[3]

1 Editorial: Anesthetics Old and New, Anesthesia and Analgesia, 23:44, Jan.-Feb. '44
2 R Blair Gould: Anaesthesia for the Patient in Shock, Anesthesiology 5:129, March, '44.
3. Major C F McCuskey: Anesthesia At The Front, The Military Surgeon, April, '44

Unsurpassed { **PURITY** / **STABILITY** / **POTENCY** } *Mallinckrodt Ether for Anesthesia*

MALLINCKRODT CHEMICAL WORKS

78 Years of Service to Chemical Users

Mallinckrodt St., St. Louis 7, Mo. • 74 Gold St., New York 8, N. Y.
CHICAGO • PHILADELPHIA • LOS ANGELES • MONTREAL

FOR VICTORY BUY UNITED STATES WAR BONDS STAMPS

A Valuable Routine Measure

Prescribed routinely before elective surgery, LIVITAMIN reduces operative risk by improving the ability of the patient to withstand anesthesia and surgery. Because LIVITAMIN is presented in liquid form, it may be administered early after surgery to overcome B vitamin and iron deficiencies if present, or guard against their occurrence. It aids in overcoming anorexia, speeds return to normal strength.

LIVITAMIN, notable for its palatability, and providing liver concentrate, readily utilized iron, and a rich store of B vitamins, will be found a valuable aid in hastening postsurgical recovery.

LIVITAMIN

Each fluidounce of Livitamin presents:

Fresh Liver (as Liver Concentrate)	2 oz.
Thiamine Hydrochloride (B_1)	3 mg.
Riboflavin (B_2, G)	1 mg.
Nicotinamide (Niacinamide)	25 mg.
Pyridoxine Hydrochloride (B_6)	1 mg.
Pantothenic Acid	5 mg.
Iron and Manganese Peptonized	30 gr.

Contains the vitamin B complex factors naturally occurring in liver and rice bran, fortified with synthetic B_1, niacinamide, B_2, B_6, pantothenic acid and with iron and manganese.

In doses of 2 to 4 teaspoonfuls t.i.d. Livitamin rapidly corrects hemoglobin deficiency. Available in 8-oz. bottles.

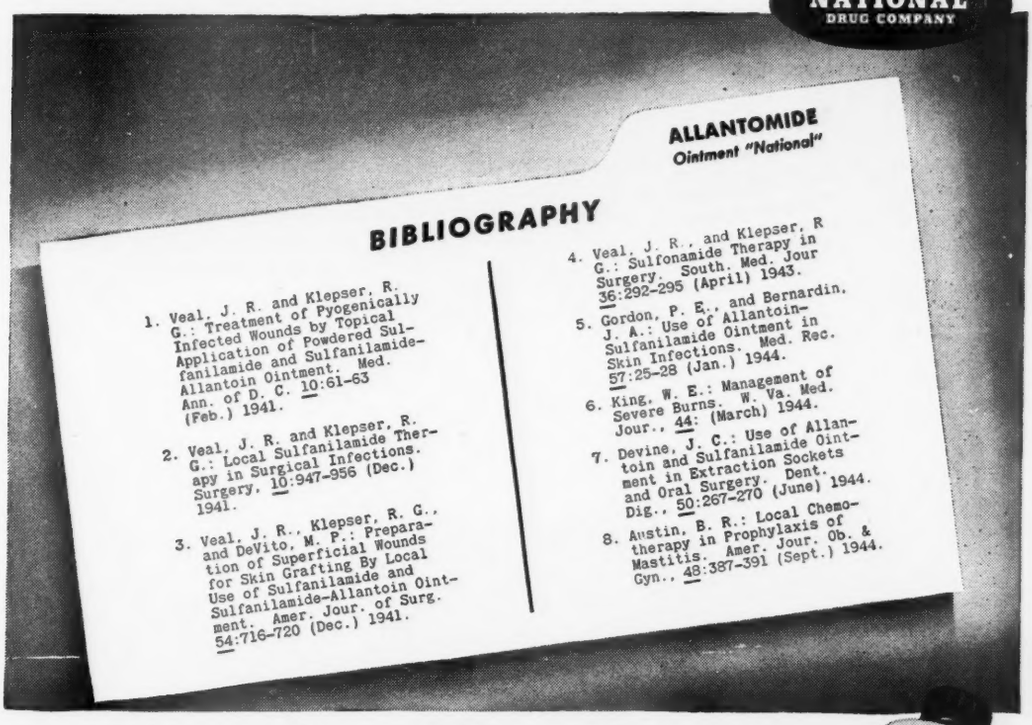
THE S. E. MASSENGILL COMPANY

Bristol, Tenn.-Va.

NEW YORK • SAN FRANCISCO • KANSAS CITY SEMCO

BIOLOGICALS, BIOCHEMICALS, PHARMACEUTICALS FOR THE MEDICAL PROFESSION

NATIONAL DRUG COMPANY

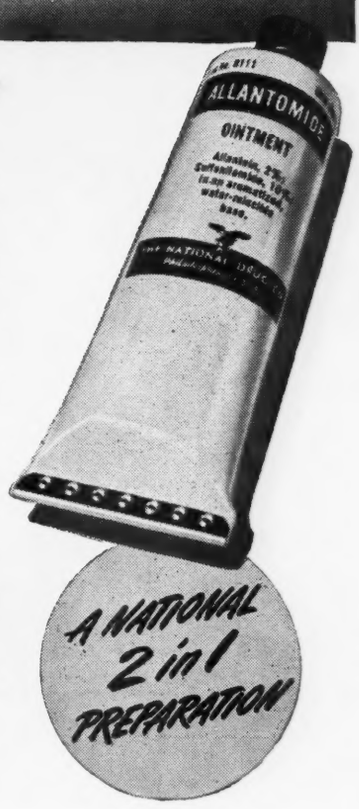

ALLANTOMIDE
Ointment "National"
BIBLIOGRAPHY
1. Veal, J. R. and Klepser, R. G.: Treatment of Pyogenically Infected Wounds by Topical Application of Powdered Sulfanilamide and Sulfanilamide-Allantoin Ointment. Med. Ann. of D. C. 10:61-63 (Feb.) 1941.
2. Veal, J. R. and Klepser, R. G.: Local Sulfanilamide Therapy in Surgical Infections. Surgery, 10:947-956 (Dec.) 1941.
3. Veal, J. R., Klepser, R. G., and DeVito, M. P.: Preparation of Superficial Wounds for Skin Grafting By Local Use of Sulfanilamide and Sulfanilamide-Allantoin Ointment. Amer. Jour. of Surg. 54:716-720 (Dec.) 1941.
4. Veal, J. R., and Klepser, R G.: Sulfonamide Therapy in Surgery. South. Med. Jour 36:292-295 (April) 1943.
5. Gordon, P. E., and Bernardin, J. A.: Use of Allantoin-Sulfanilamide Ointment in Skin Infections. Med. Rec. 57:25-28 (Jan.) 1944.
6. King, W. E.: Management of Severe Burns. W. Va. Med. Jour., 44: (March) 1944.
7. Devine, J. C.: Use of Allantoin and Sulfanilamide Ointment in Extraction Sockets and Oral Surgery. Dent. Dig., 50:267-270 (June) 1944.
8. Austin, B. R.: Local Chemotherapy in Prophylaxis of Mastitis. Amer. Jour. Ob. & Gyn., 48:387-391 (Sept.) 1944.

Positive Proof!

More and more physicians are proving the value of the allantoin-sulfanilamide combination in a hydrophilic ointment for use in daily practice as well as in controlled clinical trials.

Allantomide ointment is available for immediate use. It is easily applied with spatula after the usual technique of debridement. It does not cake nor stain. It is odorless and does not form a thick eschar to inhibit motion. Being water-miscible, the active agents in the specially developed non-greasy base are made available to mix with the aqueous secretions.

Indications: external ulcers, infected wounds or burns and chronic pyogenic infections of the skin, susceptible to the action of sulfanilamide. Write for literature. The National Drug Company, Philadelphia 44, Pa.



A NATIONAL 2 in 1 PREPARATION

Allantomide
OINTMENT

(2% allantoin, 10% sulfanilamide in a non-greasy, water-miscible base)

OTHER ALLANTOMIDE PREPARATIONS: Allantomide Vaginal Cream Allantomide Liquid with Ephedrine • Sulfonamets • Allantomide Film

Compare

THE SPEED AND EFFECTIVENESS OF 10 ANTISEPTICS IN COMMON USE

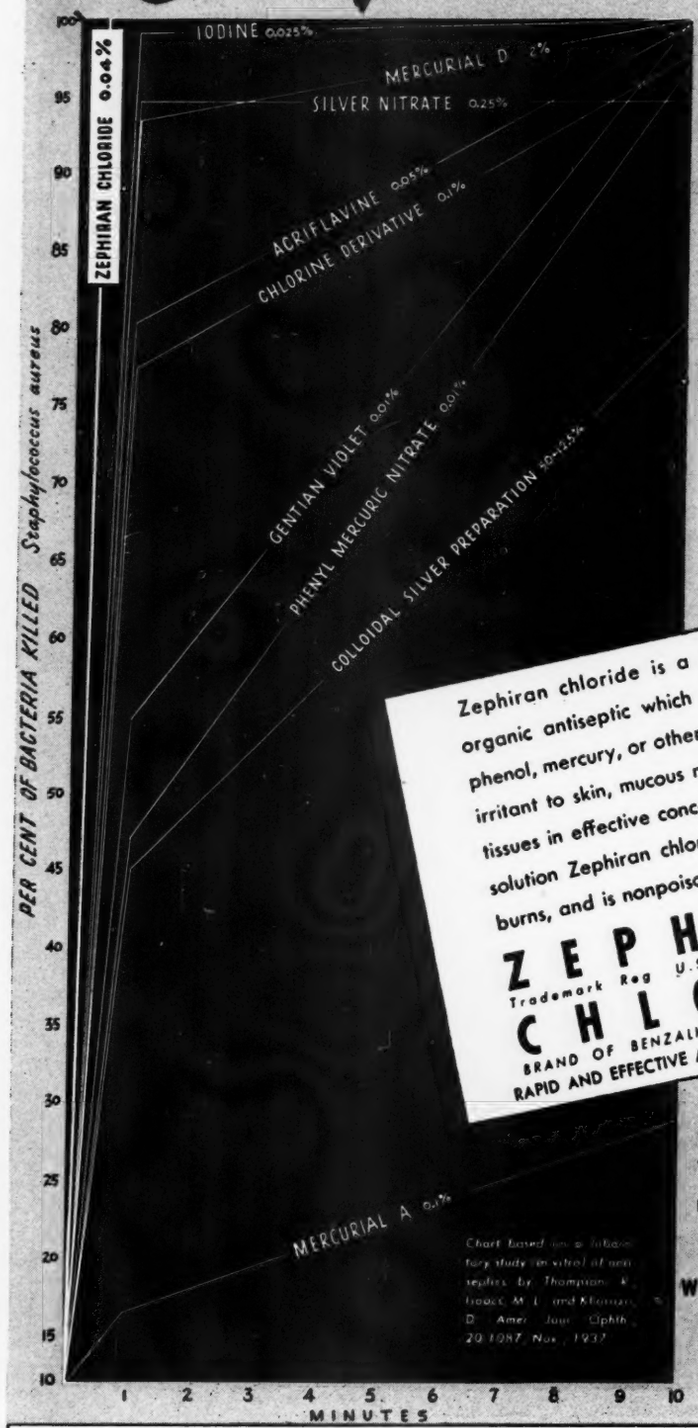


Chart based on a laboratory study on vitro of antiseptics by Thompson, R. Isaacs, M. L. and Kleinman, D. Amer. Jour. Ophth. 20:1087, Nov., 1937

Zephiran chloride is a powerful, stable, organic antiseptic which contains no iodine, phenol, mercury, or other corrosives. It is non-irritant to skin, mucous membranes or wound tissues in effective concentrations. In aqueous solution Zephiran chloride neither stings nor burns, and is nonpoisonous.

ZEPHIRAN CHLORIDE

Trademark Reg. U.S. Pat. Off. & Canada

BRAND OF BENZALKONIUM CHLORIDE REFINED

RAPID AND EFFECTIVE ANTISEPSIS WITHOUT IRRITATION

AQUEOUS SOLUTION 1:1000, BOTTLES OF 8 OZ. AND 1 GALLON. STAINLESS TINCTURE 1:1000, BOTTLES OF 8 OZ. AND 1 GALLON. TINTED TINCTURE 1:1000, BOTTLES OF 8 OZ. AND 1 GALLON.

WRITE FOR DETAILED LITERATURE

ACCEPTED AMERICAN MEDICAL ASSN

WINTHROP CHEMICAL COMPANY, INC., *Pharmaceuticals of merit for the physician*, NEW YORK 13, N. Y., WINDSOR, ONT.

Routinely AFTER SURGERY

The threat of postsurgical anemia is an ever-present hazard even today when blood loss is usually insignificant and infection is prevented and controlled by potent antibiotics.

Anemia, by producing anorexia, reduction of gastric acidity and impairment of the sense of well-being, tends to reduce food intake and thus is apt to promote debilitating deficiencies at the very time when nutrition is so essential.

The routine use of Heptuna, pre- and postoperatively, prevents or corrects postsurgical anemia by providing adequate amounts of readily utilizable iron, the fat-soluble vitamins A and D, and the B complex vitamins (partly derived from liver concentrate and yeast).

J. B. ROERIG & COMPANY
536 Lake Shore Drive • Chicago 11, Illinois

Each Capsule Contains:

FERROUS SULFATE	4.5 gr.
VITAMIN A	5000 U.S.P. Units
VITAMIN B_1 (1 mg.)	333 U.S.P. Units
VITAMIN D	500 U.S.P. Units
VITAMIN G (0.50 mg.)	500 micrograms

together with liver concentrate (vitamin fraction) derived from 4 grams of fresh liver and dried brewers' yeast.

Heptuna

a **ROERIG** *Preparation*

"For her, are the hazards of childbearing too great?"

A retrodisplaced uterus or fibromyomata—often aggravated by pregnancy—frequently leads to abortion or to marked obstetric difficulties. Pelvic deformities, too, which imperil normal delivery... or a history of repeated cesarean sections... may sometimes represent serious contraindications to pregnancy.

When necessary in such cases, control of conception may by safely obtained by the use of Ortho-Gynol Vaginal Jelly. This potent spermicidal agent is readily miscible, non-irritant and easily applied. Also available as Ortho-Creme.

ACCEPTED AMERICAN MEDICAL ASSN. Council on Pharmacy and Chemistry

ortho-gynol
VAGINAL JELLY

ACTIVE INGREDIENTS: Ricinoleic acid, 0.7%, boric acid, 3.0%, oxyquinoline sulfate 0.025%.

Copyright, 1945, Ortho Products, Inc., Linden, New Jersey

The American Journal of Surgery

ADVERTISERS INDEX

Instruments and Apparatus

A. S. Aloe Company ..... *September*
American Cystoscope Makers, Inc. ... 9
American Sterilizer Company 6
Austenal Laboratories, Inc. 8
Bard-Parker Co., Inc. 10
Becton, Dickinson & Co. 23
Clay-Adams Co., Inc. 24
Crescent Surgical Sales Co. 28
General Electric X-ray Corp ..... *September*
Fred Haslam & Co., Inc. 46
The Kansas City Assemblage Co. ... 50
Kny-Scheerer Corp. 19
Geo. P. Pilling & Son Co. ..... *September*
Propper Manufacturing Co. 44
Singer Sewing Machine Company 11
J. Sklar Manufacturing Co. 13
C. M. Sorensen Co., Inc. ..... *September*
The Tower Co., Inc. 12
Waugh Laboratories ..... *September*
Edward Weck & Co., Inc. 15
Zimmer Manufacturing Co. ..... *September*

Sutures

Armour & Co. ..... *Facing P. 8*
Bauer & Black 7
Davis & Geck, Inc. ..... *Insert Facing 2nd Cover*
J. A. Deknatel & Sons, Inc. 44
Ethicon Suture Laboratories 25
Gudebrod Bros. Silk Co., Inc. 14

Pharmaceuticals

Abbott Laboratories 26
American Hospital Supply Corp. 33
The Arlington Chemical Company .. 18
Ernst Bischoff Co., Inc. 49
Bristol Laboratories 29
Bristol-Myers Company 39
Burroughs Wellcome & Co. ..... *September*
Chatham Pharmaceuticals, Inc. ..... *September*
Ciba Pharmaceutical Products, Inc. .. *Back Cover*
Commercial Solvents Corporation 20–21
Davis Emergency Equipment Co., Inc 22
E. Fougera & Co., Inc. 41
The Harrower Laboratory, Inc. 48
Hoffmann-La Roche, Inc. 5
Hynson, Westcott & Dunning 48
Iodine Educational Bureau, Inc. 50
The Lavoris Company ..... *September*
Thos. Leeming & Co., Inc. 1
Eli Lilly and Company ..... *September*
The S. E. Massengill Company 52
Merck & Company ..... *September*
The Wm. S. Merrell Company ..... *September*
McNeil Laboratories, Inc. 40
National Drug Co. 53
Ortho Products, Inc. 56
Parke, Davis & Co. ..... *Insert Opp. P. 28*
J. B. Roerig & Company 55
Schering Corporation 37
Smith, Kline & French Laboratories .. 35
E. R. Squibb & Sons 30
Frederick Stearns & Company 31
The Upjohn Company ..... *September*
Vitamix Corp. 43
Myron L. Walker Co., Inc. 43
Wallace & Tiernan Products, Inc. 46
Wm. R. Warner & Co., Inc. 36
White Laboratories, Inc. 16–17
Winthrop Chemical Co., Inc. 2, 34, 54
J. Wyeth, Inc. 45

Hospital Supplies

A. S. Aloe, Company ..... *September*
American Hospital Supply Corp. 33
Becton, Dickinson & Co. 23
Cutter Laboratories ..... *September*
General Electric X-ray Corp ..... *September*
Fred Haslam & Co., Inc. 46
Johnson & Johnson 32
Macalaster Bicknell Company 27
Mallinckrodt Chemical Works 51
Owens-Corning Fiberglas Corp ..... *September*
J. Sklar Manufacturing Co. 13
C. M. Sorensen Co., Inc. ..... *September*
The Tower Co., Inc. 12

Post-Graduate Instruction

Cook County Grad. Sch. of Med. 42
N. Y. Polyclinic Med. School 42

Foods

Cereal Institute Inc. 47
The Wander Company ..... *September*

Books

Froben Press ..... *September*
U. S. Treasury 38

PERIPHERAL VA[illegible]AR DISEASE

Schematic drawing of superficial arteries of the palm.

[illegible]at estrogens are of value in certain types of peripheral vasomotor disturbances has been established both experimentally and clinically. One of the most recent reports on this subject deals with results obtained in a series of 345 patients treated with estrogens over the past ten years.[1] Of the various estrogenic substances used, the most effective results were obtained with Di-Ovocylin* (α-estradiol dipropionate).

DI-OVOCYLIN

*Trademark Reg. U. S. Pat. Off

[1] McGrath, E. J. and Herrmann, L. G.: Influence of Estrogens on the Peripheral Vasomotor Mechanism, Ann. Surg., 120:607 (Oct.) 1944

CIBA PHARMACEUTICAL PRODUCTS, INC. • SUMMIT, NEW JERSEY
IN CANADA, CIBA COMPANY LIMITED, MONTREAL

a Ciba Product

CIBA PHARMACEUTICAL PRODUCTS, INC.
Summit, New Jersey Dept. 19

Gentlemen:

Please send me a reprint of the article on the Use of Estrogens in Peripheral Vascular Disturbances.

Name_____

Street_____

City_____ State_____